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CONTENTS OF No. 174.

	PAGE
Life in Other Worlds. By R. A. Proctor	163
The Kalevala. II. By Edward Clodd	165
Optical Recreations. (*Illus.*) By F.R.A.S.	166
Needed Star-Surveys. By R. A. Proctor	167
Electric Light on the Brighton Railway. (*Illus.*) By W. Slingo	168
Thought and Language. IV. By Ada S. Ballin	170
Subterranean Woods	171
Short Sight. By John Browning	171
Rambles with a Hammer. By W. Jerome Harrison	172
Forms of Leaves. By Sir John Lubbock	173
Face of the Sky. By F.R.A.S.	174
First Star Lessons. (*With Map.*) By R. A. Proctor	174
Editorial Gossip	175
Reviews	177
Correspondence: Evolution *versus* Natural Selection—Mind and Body—Fallacy of Materialism, &c.	178
Our Inventors' Column	183
Our Chess Column	184

LIFE IN OTHER WORLDS.

BY RICHARD A. PROCTOR.

SO far back as 1869, I had begun to regard doubtfully the theory that all the planets are the abode of life. The careful study of the planets Jupiter and Saturn had shown that any such theory regarding these planets is altogether untenable. The great difference between them and the members of the smaller planetary family of which our earth is the chief, suggested that in truth the major planets belong to another order of orbs altogether, and that we have as much or as little reason for comparing them to the sun as for comparing them to the earth on which we live. Nevertheless, in the case of Venus and Mars, the features of resemblance to our earth predominate over those of dissimilarity; and it was natural that, while rejecting the theory of life in Jupiter or Saturn as opposed to all the available evidence, I should still consider the theory of life in Mars or Venus as at least plausible. Ideas on such subjects are not less tenacious than theories on matters more strictly scientific. Not only so, but the bearing of newly-recognised facts on long-entertained theories is not at once recognised even by those most careful to square their opinions according to the evidence they are acquainted with. Again and again it has happened that students of science (in which term I include the leaders of scientific opinions) have been found recording and explaining in one chapter some newly-recognised fact, while in another chapter they have described with approval some old theory, in total forgetfulness of the fact that with the new discovery the old theory has become altogether untenable. Sometimes the incongruity is not recognised until it has been pointed out by others. Sometimes so thoroughly do our prepossessions become "bone of our bone and flesh of our flesh" that even the clearest reasoning does not prevent the student of science from combining the acceptance of a newly-discovered fact with continued belief in a theory which that fact entirely disproves. Let the matter be explained as it may, it was only gradually that both the Brewsterian and Whewellite theories of life in other worlds gave place in my mind to a theory in one sense intermediate to them, in another sense opposed to both, which seems to accord better than either with what we know about our own earth, about the other members of the solar system, and about other suns which people space. What I now propose to do is to present this theory as specially illustrated by the two planets which now adorn our skies at night, and by the ruddy but at present invisible Mars.

But it may be asked at the outset, whether the question of life in other worlds is worthy of the attention thus directed to it. Seeing that we have not and can never have positive knowledge on the subject, is it to be regarded as, in the scientific sense, worthy of discussion at all? Can the astronomer or the geologist, the physicist or the biologist, know more on this subject than those who have no special knowledge of astronomy, or geology, or physics, or biology? The astronomer can say how large such and such a planet is, its average density, the length of its day and its year, the light-reflecting qualities of its surface, even (with the physicists' aid) the nature of the atmosphere surrounding it, and so on; the geologist can tell much about the past history of our own earth, whence we may infer the variations of condition which other earths in the universe probably undergo; the physicist, besides aiding the astronomer in his inquiries into the condition of other orbs, can determine somewhat respecting the physical requirements of living creatures; and the biologist can show how the races inhabiting our earth have gradually become modified in accordance with the varying conditions surrounding them, how certain ill-adapted races have died out while well-adapted races have thriven and multiplied, and how matters have so proceeded that during the whole time since life began upon our earth there has been no danger of the disappearance of any of the leading orders of living creatures. But no astronomer, or geologist, or physicist, or biologist, can tell us anything certain about life in other worlds. If a man possessed the fullest knowledge of all the leading branches of scientific research, he would remain perfectly ignorant of the actual state of affairs in the planets even of our own system. His ideas about other worlds must still be speculative; and the most ignorant can speculate on such matters as freely as the most learned. Indeed the ignorant can speculate a great deal more freely. And it is *here*, precisely, that knowledge has the advantage. The student of science feels that in such matters he must be guided by the analogies which have been already brought to his knowledge. If he rejects the Brewsterian or the Whewellite theory, it is not because either theory is a mere speculation for which he feels free to substitute a speculation of his own; but because, on a careful consideration of the facts, he finds that the analogies on which both theories were based were either insufficient, or were not correctly dealt with, and that other analogies, or these when rightly viewed, point to a different conclusion as more probable.

Nor need we be concerned by the consideration that there can be no scientific value in any conclusion to which we may be led on the subject of life in other worlds, even though our method of reasoning be so far scientific that the argument from analogy is correctly dealt with. If we look closely into the matter, we shall find that as respects the great purposes for which science is studied, it is as instructive to think over the question of life in other worlds as to reason about matters which are commonly regarded as purely scientific. It is scientific to infer from observations of a planet that it has such and such a diameter, or such and such a mass; and thence to infer that its surface contains so many millions of square miles, its volumes so

many millions of cubic miles, its mass so many billions or trillions of tons; yet these facts are not impressive in themselves. It is only when we consider them in connection with what we know about our own earth that they acquire meaning, or, at least, that they have any real interest for us. For then alone do we recognise their bearing on the great problem which underlies all science, —the question of the meaning of the wonderful machinery at work around us; machinery of which we are ourselves a portion.*

In suggesting views respecting Jupiter and Mars unlike those which have been commonly received with favour, it is not by any means my purpose, as the reader might anticipate, to depart from the usual course, of judging the unknown by the known. Although that course is fraught with difficulties, and has often led the student of science astray, it is in such inquiries as the present the proper, one may almost say the only, course. The exception I take to the ordinary views is not based on the fact that too much reliance has been placed on the argument from analogy, but that the argument has been incorrectly employed. A just use of the argument leads to conclusions very different from those commonly accepted, but not less different from that theory of the universe to which Whewell seems to have felt himself driven by his recognition of the illogical nature of the ordinary theory respecting the plurality of worlds.

Let us consider what the argument from analogy really teaches us in this case.

The just use of the argument from analogy requires that we should form our opinion respecting the other planets, chiefly by considering the lessons taught us by our own earth, the only planet we are acquainted with. Indeed, it has been thus that the belief in many inhabited worlds have been supported; so that if we employ the evidence given by our own earth, we cannot be said to adopt a novel method of reasoning, though we may be led to novel conclusions.

The fact that the earth is inhabited, affords, of course, an argument in favour of the theory that the other planets are also inhabited. In other words a certain degree of probability is given to this theory. But we must look somewhat more closely into the matter to ascertain what that probability may amount to. For there are all orders of probability, from certainty down to a degree of probability so low that it approaches closely to that extremest form of improbability which we call impossibility. It is well at once to take this logical basis; for there are few mistakes more mischievous than the supposition that a theory supported by certain evidence derives from that evidence a probability equal to that of the evidence itself. It is absolutely certain that the one planet we know is inhabited; but it by no means follows certainly that planets like the earth support life, still less that planets unlike the earth do so, and least of all that every planet is now the abode of life.

A higher degree of probability in favour of the theory that there are many inhabited worlds arises from a consideration of the *manner* in which life exists on the earth. If one could judge of a *purpose* (according to our way of thinking) in all that is going on around us, our earth might teach us to regard the support of life as Nature's great purpose. Earth, water, and air alike teem with life. No peculiarities of life seem able to banish life. As I have said elsewhere, "in the bitter cold within the Arctic regions, with their strange alternations of long summer days and long winter nights, their frozen seas, perennial ice, and scanty vegetation, life flourishes in a hundred different forms. On the other hand, the torrid zone, with its blazing heat, its long-continued droughts, its strange absence of true seasonal changes, and its trying alternations of oppressive calms and fiercely-raging hurricanes, nourishes even more numerous and varied forms of life than the great temperate zones. Around mountain summits as in the depths of the most secluded valleys, in mid-ocean as in the arid desert, in the air as beneath the surface of the earth, we find a myriad forms of life." Nor is the scene changed when, with the mind's eye, we contemplate the earth during past ages of her history, even to the most remote stage of her existence as a planet fit to be the abode of life. Whenever there was life at all, there was abundant life. For, though no traces remain of a million forms of life which co-existed with the few forms recognised as belonging to this or that geologic era, yet we can infer from the forms of which traces remain that others must have been present which have left no trace of their existence. The skeletons of mighty carnivora assure us that multitudes of creatures existed on which those monsters fed. The great sea-creatures whose remains have been found, attest the existence of many races of small fish. The mighty Pterodactyl did not range through desert aërial regions, for he could exist only where many orders of aërial creatures also existed. Of minute creatures inhabiting the water we have records in the strata formed as generation after generation sank to the sea bottom after death, whereas the correspondingly minute inhabitants of the land and of the air have left no trace of their existence; yet we can feel no reasonable doubt that in every geologic age, forms of minute life were as rich in air and on the land as in the sea, or as they now are in all three. Of insect life all but a few traces have passed away, though occasionally, by some rare accident, even so delicate a structure as a butterfly's wing has left its record, not only attesting the existence of hosts of insects, but showing that delicate flowers, with all the charms of sweet perfume and variegated colour, existed in those times as in ours. It is no mere speculation, then, but the direct and unquestionable teaching of geology, that throughout the whole time represented by the fossiliferous rocks, life of all kinds was most abundant on our earth.

(*To be continued.*)

* It has often seemed to us that a description, by the close observer Dickens, of the fancies of a brain distempered by fever, corresponds with feelings which the student of science is apt to experience as the sense of the awful mystery of the universe impresses itself on his soul:—"The time seemed interminable. I confounded impossible existences with my own identity. . . . I was as a steel beam of a vast engine, clashing and whirling over a gulf, and yet I implored in my own person to have the engine stopped, and my part in it hammered off." Of all the wonders that the student of science deals with, of all the mysteries that perplex him, is there aught more wonderful, more perplexing, than the thought that he, a part of the mighty machinery of the universe, should anxiously inquire into its nature and motions, should seek to interpret the design of its Maker, and should be concerned as to his own share in the working of the mysterious mechanism?

The School of Submarine Telegraphy and Electrical Engineering.—This school, which we have already had occasion to notice, is still increasing in popularity and utility. The managers (Messrs. W. N. Tiddy and W. Lant Carpenter, B.A., B.Sc.), have increased the period of tuition from nine to twelve months. Increased attention is being devoted to telephony, electric lighting, and the transmission or distribution of power, and every possible facility is offered to the student to attain the highest possible degree of efficiency. Parchment certificates are awarded to those pupils who, by their industry and application, are able to secure 70 per cent. of the maximum number of marks at the final examination to which they are subjected. It is only on behalf of these successful pupils that recommendations for employment are made, hence the recommendation of the managers becomes virtually an "Open Sesame" in the hands of zealous embryo electricians.

THE KALEVALA.

By Edward Clodd.

II.

THE national feeling among the Finns, fostered by their new masters as a diversion against vain aspirations for the future, turned to the neglected past, whose greatness and glory were enlarged by the refracting medium of the imagination, like the seemingly swollen sun as he sinks in the west. Interest in all that related to Finnish history and literature was deepened, and effort was stimulated to preserve the fast-perishing fragments of popular verse and legend telling of heroes who had done mighty and renowned deeds for the fatherland, and whose spirit was not dead, but sleeping. Despite the labours of Porthan, Ganander, and others in the last century, much of this oral folk-song had been lost; the native bards lamented, "As for the lays of old time, a thousand have been scattered to the wind, a thousand buried in the snow. . . . As for those which the Munks swept away and the prayer of the priest overwhelmed, a thousand tongues were not able to recount them."

Happily the work fell into right hands. Among the earliest labourers was Topelius, a physician, whose journeys into the north of East Bothnia brought him into contact with both shamon and runic singers, and the songs which he collected, the first fruits of a goodly harvest, were of immense value as indicating relation to some large cycle of poems. The track thus opened was followed by Dr. Elias Lönnrot,* who devoted nearly seven years to eager and often perilous search after the scattered relics. He scoured the length and breadth of the land, visiting the remotest districts as the more promising ground for securing the songs in uncorrupted form, making himself at home in the humblest cabin with the grandam and the child, the fisherman and the boor, and overcoming, as he best could, by skill and tact, the reluctance of these unlettered believers in the magic power of words to repeat the ancient and venerated runes to stranger ears. In this the services which as a doctor of medicine he rendered to the sick and suffering, availed him much. But it was from the Runaios, the professional singers of the districts, that he recovered the larger portion of fugitive, and yet related, fragments of the unwritten songs. These native bards would lighten the dreariness of their long, dark winters by engaging in contests of memory, clasping each others' hands and singing the runes in turn, no rune being repeated, till the one whose memory first failed him loosened hold. But for this custom the songs would have long ago perished. Lönnrot's labour of love was well rewarded in the recovery of many isolated folk-songs more or less ancient (which were published under the title of the *Kanteletar*, from *Kantele*, a kind of harp in use among the Finns), and, what is the crowning glory of his endeavour, of the cycle of related songs which is named the *Kalevala*, or "The Home of Heroes" (from *Kaleva*, heroic, and *la*, a local suffix). These last, which were published in 1835, comprised twelve thousand lines or verses, divided into thirty-two runes or cantos. Their value and importance was recognised with enthusiasm by the learned, prominent amongst whom was the celebrated Jacob Grimm, who unhesitatingly classed the Kalevala with the great epics of the world, both in the underlying unity which connects the whole, in the splendour yet simplicity of its diction, in the richness and freshness of its imagery, and in the love and appreciation of nature which runs through the entire work. It is no exaggeration to say that it is to the Finns what the Ionian songs were to the Greeks, the Nibelungen Lied to the Teutons, the Maha-Bharata to the Hindus, and the Shah-Nameh to the Persians.

Through the further researches of Dr. Lönnrot, Castrén, and others, the *lacunæ* in the Kalevala were filled by the discovery of fifteen more runes, and in 1849 the complete work, consisting of twenty-two thousand seven hundred and ninety-three lines (seven thousand more than the Iliad), divided into fifty runes, was published.

The first edition was translated into Swedish by the great Finnish mythologist, A. Castrén, the manner of whose death, as he wrote the last lines of his important work on Finnish mythology, recalls the well-known story of the Venerable Bæda, dictating, as he lay dying, the closing words of his translation of the Gospel of St. John. The complete Swedish version has been rendered (according to M. le Duc, with some sacrifice of accuracy to elegance) by K. Collan, of Helsingfors; the German translation by the learned A. Schiefner; the French by the above-named writer, M. Leouzon le Duc; but as yet no translation into English has been made. In fact, our sources of knowledge outside the above are meagre and fugitive; some references in the works of Max Müller, Sayce, and Tylor, a small volume of selections by the late Professor Porter of Yale College, prefaced by an analysis of the poem; abstracts in Dr. Latham's "Nationalities of Europe,"* in Mr. Lang's essay, and in an instructive review of Castrén in *Fraser's Magazine*, May, 1857,† complete the list. The metre in which the Kalevala is composed—the eight-syllable trochaic, characteristic of all Finnish poetry, and mostly common to Ural-Altaic—is familiar to the readers of "Hiawatha," having been adopted by Longfellow from the Swedish version as a sonorous measure for the Indian legends on which his poem is based; and which, like all tales of primitive races, were chanted in cadence, and transmitted through the easier mnemonic vehicle of rhythmic form.

The Kalevala is unique among epics. Its several parts are less closely related than those of the Iliad, but, although not the work of a single age or author, although various ideas from foreign sources have been embodied in them (notably in the closing rune, when the Virgin's son, the child Christ, appears, at whose coming Wäinämöinen departs for unknown lands), and although their connection is consequently broken, their unity is not obscured.

It is unlike other epics in the absence of any apotheosis of clique, or clan, or dynasty, and in the theatre of action being in no ideal world, where the gods sit lonely on Olympus apart from men. Its songs have "a common author, the whole Finnish people;" the light of common day, more than that of the supernal, illumines them. The heroes not only bring down gifts from heaven for men, and work their wonders by aid of magic, but mingle in the daily life of the people, sharing their toil and entering into their rest. They are, as Mr. Lang remarks, "exaggerated shadows of the people, pursuing on a heroic scale, not war, but the common business of primitive and peaceful men."

Moreover, the Kalevala, which opens with a creation-myth of the earth, sea, and sky, from an egg, is a perfect storehouse of unadulterated mythology, and, as the foregoing remarks would indicate, of folk-lore and popular customs; also of beliefs in transformation, in a common life shared by man and animal, in lifeless things as endowed with speech and virtue; in brief, in all the tangled and

* Dr. Lönnrot died in the spring of last year. (Vide *Athenæum*, March 29, 1884.) M. le Duc's words may be endorsed wherever the story of Lönnrot's work is told:—"Ces deux ouvrages ont à jamais immortalisé le docteur Lönnrot. On l'a surnommé l'Homère finlandais."—Introduction to "Le Kalevala," p. 9.

* Vol. 2, pp. 182-209. † "Mythology of Finland."

bizarre philosophy characterising the barbaric mind. But although essentially of the people and about them, with the actual world of living men pictured in faithful detail, there is a leading *motif* to which all the incidents are subordinate, and, with more or less intention, supplemental. This is the struggle between Wäinämöinen, Ilmarinen, and Lemminkainen, of the bounteous, sunny land Kaleva, and Louki, Hiisi, and Joukahainen, of the cold, drear, northland Pohjola, and the dark underworld Tuonela, the main object of the conflict being the capture and abduction of brides from Pohjola, an incident in which evidence of exogamy, or marriage outside the tribe among the ancient Finns, is perhaps preserved. In the end, the victory is with Wäinämöinen. Here are materials promising enough for the solar theorists, with their happy facility in making anything mean everything, to work upon; for are not Kaleva and Pohjola the light and the darkness, and the chase and capture of Louki's daughter, the winning of the dawn-maiden by the amorous Sun?

The nature-origin of the leading characters in the Kalevala is clear, and it is not contended that celestial phenomena, personified by man's rude analogy, have not been an important factor in the evolution of primitive myth. Thus far, there is no quarrel with the so-called comparative mythologists. But the poems have other elements than the meteorological, and in their own sphere, not less turbulent, being born of the passions, and ambitions, and unrest of men. Such are love and song, and war, and intrigue, and of these the Kalevala has no lack.

It was remarked in the former paper, that the only mythology showing any correspondence with the Finnish, is that of the Esthonians, and in comparing their epic, the Kalevipöeg, with the Kalevala, the groundwork is found to be identical. The Esthonians, however, tell of their heroes as the offspring of Vanna Issa, begotten before the foundation of the world, while the Finns regard their heroes as the offspring of the celestial virgin, Daughter of the Breezes and the Air. In the Kalevipöeg, which is less archaic than the Finnish epic, Vanna Issa creates heroes to avail himself of their skill and counsel.* The eldest is Vannemuine, created old and with the wisdom of age, but young in heart, and with the gift of song. When the god is troubled, Vannemuine soothes him, as David soothed Saul, with harp and song. The second hero is Ilmarine, endowed with strength, and an artificer like Tubal Cain. The third son is Lœmmekune, a rollicking, wanton youth. To them, the Ancient Father, with whom they dwell in Kalleve, makes known his intent to create the world, and this he does while they sleep. On awaking they are astonished, and then, while Vanna Issa, wearied with the work of creation, lies down to rest, Ilmarine hammers a metal vault, which he strains like a tent over the earth, hanging therefrom the sun and nailing thereon the moon and stars. Full of gladness, Vannemuine sprang upon the earth, strikes his harp, and sings a song of joy, so that the birds followed him, and wherever his foot touched the ground, flowers blossomed forth and trees grew. This and the merriment of Lœmmekune wakened the Ancient Father, who praised the heroes for making the rough world beautiful. "Soon," said he, "will I people the world with all manner of beasts, and then will I create men who shall rule the world; but man I will make feeble, so that he may not boast of his strength. And ye shall befriend mankind, and mingle with them, so that a race may arise that shall not so easily succumb to evil; for evil I must not and cannot destroy, because it is the measure and goad of good."

* The identity of the names of the Kalevipöeg heroes with those of the Kalevala, as of Kalleve with Kaleva, is obvious.

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

(*Continued from p.* 441, Vol. VI.)

BEFORE proceeding to another division of our subject, we will describe a second and more simple method of producing a distorted figure; which, viewed from a proper point of sight, will appear absolutely regular. Here, again, we shall illustrate what we have before insisted on (Vol. V., p. 437, and elsewhere), that rays of light go and return by precisely the same route. In Fig. 35, B B′ repre-

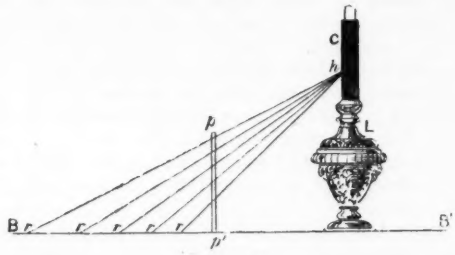


Fig. 35.

sents a drawing-board upon which paper is strained. $p\,p'$ is a plate of glass standing upright upon it, and on this glass is painted the object or scene of which we wish to form our distorted image. L is an ordinary lamp, the

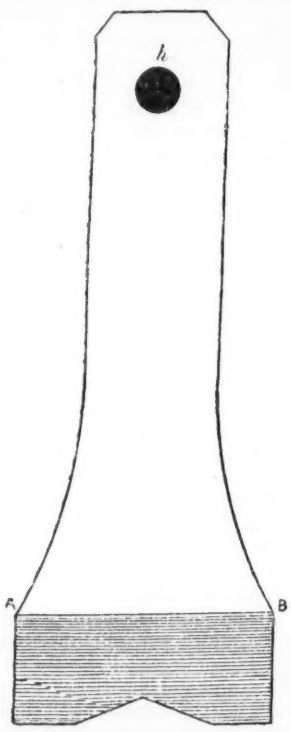


Fig. 37.

chimney of which is surrounded by a tin cylinder, C, blackened outside, and with a hole, h, $\frac{1}{4}$ inch in diameter, perforated in it, opposite the middle of the flame. A glance at the figure will show how the rays $h\,r$, $h\,r$, passing through the plate of glass, will project an image of

the device painted on its surface between B and p'. Over the outlines of this distorted image we carefully trace with a pencil, and then finish up our drawing in the usual way. Now, bearing in mind the principle which we are illustrating, it will be quite evident that, to an eye placed at h, the rays from our distorted picture will pass through and

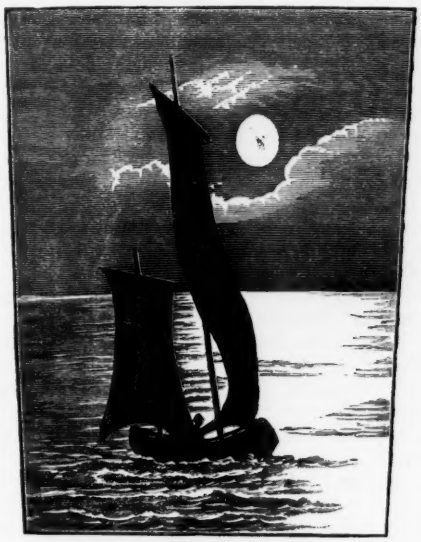


Fig. 36.

seem as though they emanated from the corresponding normal image on $p\,p'$, so that we have only to contrive some arrangement for causing the eye to occupy this place, and to remove $p\,p'$ altogether, to see an absolutely regular picture. This may be done by cutting out a strip of card (Fig. 37), perforating it with a hole of the same size ($\frac{1}{4}$ in.) as h, and at the same height from B B', and then removing the lamp, and placing it so that this hole occupies the precise position that h did. To illustrate this, we have drawn a slightly-distorted view (Fig. 36) of a fishing-boat on a moonlit sea. The size of this page is the chief obstacle in the way of the distortion being made greater, but the "lanky" appearance of the masts and sails, and the elliptical moon, will indicate in what direction deformation has taken place. The reader must now cut out a piece of card of the exact size and shape of Fig. 37, with a hole, as shown, at h; cut it half

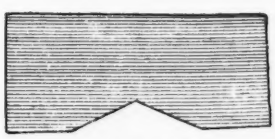


Fig. 38.

through with a penknife along the line A B, and bend it back at right angles. The part shaded in our figure must now be placed upon Fig. 38, and the observer, on looking through the hole h, will see Fig. 36 in its true proportions.

At a meeting held at Liverpool on Monday, the Mayor presiding, it was resolved to hold in that city, next year, an Exhibition illustrative of navigation, travelling, and commerce. The central feature is to be ship construction and shipping industries; but it will also include exhibits illustrative of all modes of travelling—ancient and modern—by land, sea, and air, in our own and foreign countries.

NEEDED STAR-SURVEYS.

By Richard A. Proctor.

(*Continued from p.* 120.)

THE broad general results deducible from my equal-surface chart of 324,198 stars were very striking. According to the older theory of William Herschel's we do not come *near* the boundaries of the sidereal universe with such a telescope as Argeländer used. Except for some few exceptionally large suns at distances where ordinary suns would not be reached by such a telescope (only $2\frac{1}{2}$ inches in diameter) there should be no greater number of stars in the Milky Way zone observed with so small a space-penetrating power, than elsewhere. Even for such exceptionally large suns Herschel's theory made no allowance. But what is actually the case? These stars which ought to be no richer on the Milky Way, are actually so much richer that by their increase of wealth they positively show the Milky Way on the chart almost as clearly as if it were mapped there! It is manifest that the circumstances of the survey by no means favour such a result, but the reverse. Every one who has ever studied the star depths knows that a star which is quite clearly seen when alone or with few others in the field of view, may be undiscernible when the whole field of view is crowded with stars as in the richer regions of the Milky Way. Many stars then were lost in Argeländer's survey of the richer fields which would have been well seen had they been in poorer regions. Thus great as are the numbers of stars seen along the Milky Way regions in my chart there would have been many more had the chance of catching faint stars here been as great as elsewhere. This I carefully tested. Reducing the power of my much larger telescope until it was about equal to that of Argeländer's instrument, I examined certain rich galactic regions surveyed by him, and others far from the galaxy, satisfying myself by using various ways of reducing the field so as to exclude the blaze from many stars in the former case, that whereas Argeländer and his assistants could have seen but few more stars in the non-galactic parts of the heavens even though they had limited their observations to the darkest and clearest nights, they could have seen half as many stars again in the Milky Way had they reduced their field of view in such sort as to avoid the blaze of multitudinous stars.

Thus marked though the increase of star wealth is in the Milky Way regions as observed by Argeländer, the increase could have been very much greater if all the stars within the range of his telescope had been recorded.

The inference from this increase of wealth on the Milky Way is obvious and important. We learn that just as the rounded rich regions along the Milky Way are really round (*i.e.*, roughly globular) regions of space, in which multitudes of stars of many orders of real size are strewn, so the streams of the Milky Way are real stream-shaped or branch-shaped regions in space in which not only the very small stars as observed by the Herschels with their great gauging telescopes are much more richly strewn than elsewhere, but also stars very much larger, and well within the range of very small telescopes indeed.

Extending the principle yet further, I have made (and published) investigations into the distribution of stars visible to the naked eye, finding them much more numerous on the Milky Way than elsewhere, and otherwise less uniformly arranged than had been supposed. (In this work I used scissors and a delicate balance to give the areas of irregular regions of the heavens.) I even examined the distribution of stars down to the fourth magnitude only, finding it by no means uniform, and well worthy of attention.

XUM

I have further applied the same method of charting to the star clouds (using Professor Cleveland Abbe's excellent statistical results* as the basis of my work, finding the clearest and most convincing evidence that the nebulæ form part of our sidereal system.

I have further charted the stellar proper motions,—the only possible way of recognising any law in these movements. Such charts show that many large groups of stars have a common drift, so as manifestly to form separate systems. In the only case where one of these sets of stars has been dealt with by the spectroscopic method for determining motions of recession and approach, it has been found that (as I specially predicted in that case†) the stars all had a common motion in the direction of sight, as well as athwart that direction. This showed that the evidence given by charts of proper motions is trustworthy.

But this is the merest beginning. We want surveys of the heavens made with many other powers,—as with a 1½-inch telescope; a 4-inch telescope (this I have partly tried, and I know the results of a full survey would be most valuable); with a 6-inch telescope; and with a 12-inch telescope: the more interesting regions disclosed by such surveys as these being then examined with the highest telescopic powers that can be brought to bear upon them. It is essential that the southern hemisphere should be at least as carefully surveyed as the northern; for no one who has ever looked at the southern skies can fail to recognise that they are much more variegated, and therefore much more likely to be instructive in regard to celestial architecture, than the skies north of the equator.

Lastly, these surveys should be accompanied by widely extended study of proper motions; by the application of the spectroscope to determine the constitution of stars in different parts of the heavens, and their movements of recession and of approach.

I venture to predict that as this work proceeds, for I am sure it will in due time be undertaken, science will be compelled to give up more and more the idea of uniformity of structure within the stellar universe, recognising a grandeur and complexity in its architecture, a variety yet harmony in its movements, and a significance in its amazing vitality, akin to but of a far higher order than the corresponding qualities within the planetary system.

THE ELECTRIC LIGHT ON THE BRIGHTON RAILWAY.

By W. Slingo.

AMIDST the many inconveniences that await the average railway traveller, there is, to my mind, not one that is more trying or vexatious than to be compelled to sit out a long journey in a carriage illuminated (!) by the old, dirty, smoky oil-lamp. Nevertheless, until very recently, this is what one and all had to do whose business or pleasure involved them in a railway journey at a time when sunlight was absent; and even now we are oftener than not compelled to undergo the same torment.

The introduction of the Pintsch Gas system wrought a revolution on a small scale. Our underground railway trains are fitted under it, and it has found support in a few other directions. But the greatest result, perhaps, which has been brought about by even a limited application of the system is that it has shown the public that a light superior to that given by oil is practicable; and, were nothing else available, the railway companies would, sooner or later, be compelled by force of public opinion to adopt it.

There is, however, something which is superior to gas even in a railway carriage, and that something is electricity. We certainly owe it to the eminently able and enterprising management of the London, Brighton, and South Coast Railway that electricity, as an illuminating agent in railway carriages, has been proved; for the first experiments in this direction were made by that company some three years ago, when the Pullman express, which runs daily between the Victoria and Brighton stations, was lighted by electricity. In that case accumulators of the Faure type—some of the very first brought into England—were employed.

They were charged overnight at Victoria by means of a dynamo worked by a gas-engine (wires being led from the shed to the brake-van), and supplied throughout the day sufficient current to illuminate the twenty-eight lamps fitted in the various carriages composing the train which performed the journey from London to Brighton and back twice daily.

The advantages of the system over the previously-employed oil-lamps were, it is almost needless to say, too real and too apparent not to secure at once the admiration and gratification of the patrons of the line. The light was steady, clear, and only showed itself when wanted.

Illumination by oil or gas means that in the day-time, if the train has to run a fifty-mile or even longer journey, and has one or two short tunnels to traverse, the lamps must all be burning through the entire length of the journey on account of the tunnels.

With the electric light this is not the case. The guard is provided with a simple switch, by turning which he is able to send the current into the lamps on approaching a tunnel, and to stop the current on emerging from the tunnel. Here, then, is a very decided advantage in favour of electricity.

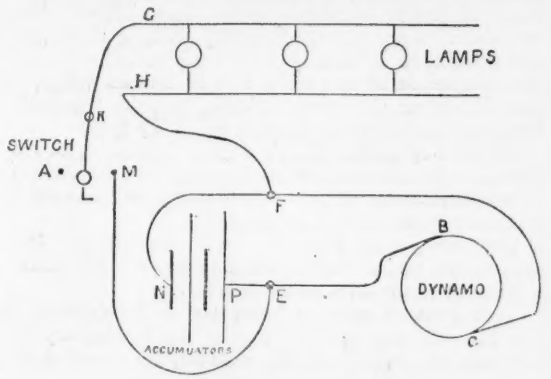
The train thus fitted has continued its daily journeys since the inauguration of the system, but there were soon discovered many features in connection with it that required modification before it could become the commercial success that was hoped for it. In the first place, there was the expense of the gas-engine and its attendant. This is a serious objection, to say nothing of the allowance that ought to be made for renting the engine-house. It may, however, be observed that, were the system extended to several trains instead of a single one, so as to divide the engine and accessory expenses between them, the cost per train would obviously be considerably reduced.

In the following year a new system was introduced, and employed on the London-bridge and Brighton express, and on a local train running between Victoria, Crystal Palace, and London-bridge, &c. It had been worked out by Mr. Stroudley, the talented engineer to the company, and Mr. Houghton, its energetic telegraph superintendent. In this system the engine was discarded entirely, and the dynamo was fixed in the brake-van, and worked from a counter-shaft geared on to one of the axles. While the train travels at a sufficiently-rapid rate, it is easy to see that the dynamo might be driven fast enough to feed the lamps. But whence is the electricity to come necessary to illuminate the lamps when the train is travelling slowly or when it is standing still? This is accomplished in a very simple manner. While the train is running rapidly, electricity may be generated, whether the light is wanted or not. Consequently, the dynamo, B C, is permanently connected to a set of twenty accumulators, N P.

* I had already charted the nebulæ on a less complete plan before Prof. Abbe had obtained those results.

† The group of stars β, γ, δ, ϵ, and ζ of the Great Bear, with ζ's small companion, Alcor, called in country parts of England "Jack by the Middle Horse."

Other wires, however, are connected at E F to the wires joining the dynamo to the accumulators, and these other wires are connected to the lamps in the various parts of the train. It follows that, were there no electrical energy stored in the accumulators, the current from the dynamo would divide between them and the lamps. The accumulators are never wholly discharged, however; but, even were they so, sufficient charge would soon accumulate to prevent this division, for it must be remembered that electricity, in charging accumulators, sets up a "counter electro-motive force," and if this force is equal to that of the generator no electricity will flow



into it, although a very small difference is sufficient to maintain a current. Moreover, when the lamps and accumulators are all in circuit, but little electricity will flow into the latter, because the "difference of potential" between the dynamo and lamps is equal to that between the brushes of the dynamo itself, while the "difference of potential" between the dynamo and accumulators is only a fraction of that amount; and, as the greater proportion of electricity flows between points of greater difference of potential, nearly the whole current produced will be absorbed by the lamps.

A switch is provided in the lamp circuit, so that the guard may be able to disconnect it when the light is not required. The current will then be utilised by the accumulators. In the diagram, K L is the handle of the switch hinged at K. When L is over A, the lamps are disconnected, but when it is over M, they are in circuit.

One great feature of the Stroudley-Houghton system is the automatic controlling apparatus. This originally took the form of a governor, which was fitted in November, 1883; but in August, 1884, the work in the local train was transferred to a mercury pump. This consisted of two vertical tubes, the lower ends of which opened into a cylinder. In this a coarse-threaded screw was made to revolve by being connected to a small pulley-wheel, over which passed a strap, which also passed round the spindle of the dynamo. When the train was in motion the pulley-wheel revolved, and with it the screw in the cylinder. The cylinder and lower portions of the tubes being filled with mercury, the revolution of the screw caused the mercury, to fall in one tube and rise in the other. At a certain height in each tube, above the normal level of the mercury, was an adjustable contact point, and the mercury, on reaching one or the other, completed the dynamo's exciting circuit. When the train travelled in one direction, the pulley-wheel travelling with it would bring about the rise of the mercury in one tube; when it travelled in the opposite direction the mercury would rise in the other tube. The "shunt" circuit thus closed, in turn joined up the main circuit automatically.

There was another and most important function pertaining to the mercury pump. The electromotive force produced in the coils of a dynamo varies with the speed at which the armature rotates. Accordingly, when running slowly (or not running at all), the accumulators would have a higher electromotive force than the dynamo, and if the circuit between them were complete, the former would discharge themselves through the coils of the machine. The mercury pump, however, prevents this. The gearing which drives the screw is so arranged that the mercury is made to rise in one of the tubes only when a speed of twelve miles an hour is attained. At that speed the dynamo runs fast enough to produce the necessary electromotive force.

The dynamo originally used was one of Messrs. Siemens' machines (type D 2). After some months, this was superseded by a Brush machine, provided with a Schuckert armature; but any dynamo having the necessary electromotive force can be employed, and it is now proposed to use dynamos which are free from the chief disadvantage of a Brush machine—viz., that it will not respond to demands for an increase of current in emergencies. The current produced is one of 56 ampères, with an electromotive force of 45 volts. A double set of "brushes" is provided, in consequence of the frequent change in the direction in which the armature rotates, and they are so fitted as to work automatically.

The thirty-two accumulators originally fitted were of the first type of Faure cell, which did not answer so well as was hoped, but those now employed give every satisfaction, test well, and have been in daily use in the Pullman Limited Express since December, 1882, showing a result in every way satisfactory. There is this to be said, that the vibration of the train may be calculated to do them more good than harm.

There are in the express train 56, and in the local train 39 Woodhouse and Rawson incandescent lamps, each taking about 1·15 ampères, with an electromotive force of 40 volts. Other lamps have been tried, but Mr. Houghton's experience is that their carbon filaments are too fragile to withstand the vibration of the train, while the lamps now in use have answered every requirement for the past eleven months.

A train fitted up on the Stroudley-Houghton system has lately started running on the South-Eastern Railway, between London and Maidstone.

The weight of the accumulators is about 22 cwt., and of the dynamo 8 cwt., making in all 30 cwt.

The local train, which offers certainly the severest test, has been running continuously for fourteen months, making about 3,200 trips, and running about 40,000 miles, giving during that time every satisfaction. The trains have been equipped by the Railway Electrical Contractors (Limited), 4, Great Winchester-street, E.C., and the result speaks well for the managing-director, Mr. T. M. Collet.

With reference to the relative cost of the system, complete details cannot be given. The cost of the oil previously consumed and wasted is saved, and this is a considerable item. There is no cost for lamp-cleaners, as the lamps require no cleaning. The energy absorbed by the lamps is but three electrical horse-power; and, making the widest allowance for waste in the dynamo and bearings, the additional consumption of coal in the engine is small. As a matter of fact, the driver is unable to detect any difference in the consumption; and many a time has it happened that the driver has not been aware of the fact that he is lighting the train as well as drawing it, until he has arrived at the end of his journey. Practically, then, the cost of the light is almost reducible to depreciation of

XUM

stock (wearing out of dynamo and accumulators, breakage of lamps, &c.) and interest on capital outlay. Labour costs but a tithe of that which is necessary for oil lamps, all that is required being occasional inspection and lubrication.

It is earnestly to be hoped that the success of the enterprise will increase, and prove in every sense of the word satisfactory; and that the day may not be long in coming when we shall regard oil lamps as another relic of the "good old times."

THOUGHT AND LANGUAGE.

By Ada S. Ballin.

IV.

In my last article I quoted a few instances selected from a very large amount of evidence, tending to prove that there are a number of tribes now in existence whose languages are incomplete, and have to be supplemented by the use of gesture-signs, without which they cannot express ideas even of ordinary import; and that many other such have been extinguished, as it were, by the whirlwind of encroaching civilisation.

While remarking, however, on the large array of evidence on this subject which has been amassed by various travellers, Mr. Tylor, with characteristic justice, points out that such incompleteness of language could only be proved "by the evidence of an educated man so familiar with the language in question as to be able to say from absolute personal knowledge, not only what it can, but what it cannot do,"* a degree of knowledge possessed by very few indeed. Most travellers are rather fond of jumping at conclusions, and throwing as much glamour as possible about those conclusions in order to increase the interest taken in their work.

Another source of fallacy is to be found in the fact that the natives, in speaking to strangers, would naturally gesticulate more than among themselves, in order to make their meaning better understood—just as the average Englishman whose knowledge of French is decidedly limited helps himself out of linguistic difficulties when he is among French people by means of strongly-marked facial expressions, not to say grimaces, nods, and shakings of the head, and the common language of manual signs.

But, even allowing for all sources of fallacy, there is such a consensus of opinion on the part of travellers amongst widely different tribes, that there is every reason to believe that the lower the state of civilisation the greater is the use of inarticulate expressions and of gestures, and that these take the place which in the higher states are occupied by words.

"The matter is important, ethnologically," as Mr. Tylor says, "for if it may be taken as proved that there are really people whose language does not suffice to speak of the common objects of every-day life without the aid of gesture, the fact will either furnish about the strongest case of degeneration known in the history of the human race, or supply a telling argument in favour of the theory that the gesture-language is part of the original utterance of mankind, which speech has more or less fully superseded among different tribes."†

The first alternative, which Mr. Tylor can hardly be suspected of proposing seriously, is, of course, unacceptable in the present state of science: for science has made it difficult to believe that man came into existence a perfectly intellectual and highly-civilised being, and, although it is proven that degeneration does take place—as, for instance, in the case of the modern Greeks—the tribe or nation must have risen to a certain pinnacle of civilisation, before it could fall from its high estate; so that, while allowing that there is such a thing as retrogression, we must still stand by the main principles of evolution. The law of nature is progress, but occasionally, owing to adverse circumstances, a tribe or nation seems to retrace its own steps backwards, and to reach a point which it passed long before.

Hence, we may say that if a people who once possessed a fairly complete language have lost the more intellectual part, and are content to eke out their imperfect speech by gestures, it is merely a case of Atavism, a reversion to the ancestral type of language—just as those children who are occasionally born with rudimentary tails, or those people who are able to voluntarily move their scalps and ears by the contraction of a muscle, rare in human beings, but general among the lower animals, may be regarded as instances of reversion to an ancestral bodily type.

Hence, I adopt Mr. Tylor's second alternative, and look upon the prevalence of gesture-language all over the world as a most powerful support to the theory that man did not originally possess articulate speech.

The word *gesture* has a very wide signification. It can be, perhaps, best defined as muscular action which conveys a meaning to the mind of the beholder.

Thus gestures may be voluntary or involuntary, for the onlooker can equally recognise the involuntary start and stare of surprise and the voluntary frown and shaking of the fist which he interprets as a menace.

Gestures may be divided into three classes, corresponding to the three divisions of mind—sensation, volition, and thought. These are: (1) those that express feelings, which are chiefly involuntary; (2) those which express desires or commands; and (3) those which convey knowledge from man to man—express thoughts.

I adopt this order because it appears to be the natural order of evolution. Sensation begat volition in the struggle to avoid pain; volition begat thought in order to devise means of avoiding pain.

Sensation has its root in that reflex action which, as soon as there is a trace of a nervous system, takes place, in order to preserve the individual, and through it the species; it increases in definiteness because increase of sensitiveness is an increase of preservative power, and the less well-endowed perish while "the fittest survive."

In the same way, volition grew out of sensation, and thought from volition.

It is not possible to fix a definite time when one of these parts of mind existed and the other or others did not, for in the course of successive generations the one merged itself gradually into the other until all were complete, and, until that was accomplished, it is impossible to say that mind existed as such. In mind, as we know it, feeling, will, and thought are so closely interwoven, that although we may separate them logically, and so discuss them apart, we can hardly conceive one as existing without the other.

The language of sensation is the earliest language—it is the objective side of reflex action: for sensation in its rudimentary stage was accompanied by certain outward manifestations which may be regarded as the germs from which gesture-language was evolved.

The onlooker interprets those manifestations which accompany sensations by the light of introspection attributing to others feelings similar to those he would experience in similar circumstances. Thus, if I were to put my finger in proximity to a plant, and see the flower close and shrink away, that reflex action would speak to me, and tell me, "I am a sensitive plant, and shrink away, lest you should hurt me."

* "Early History of Man," p. 80. † *Id.*, p. 79.

These reflex actions, which to us are gestures, are inherited from generation to generation; they exist as much in the highest organisms as in the lowest; the newly-born human infant draws its foot away if tickled with a feather, just as the sensitive plant shrinks from the approaching finger.

Thus it may be said that the A B C of the gesture-language is unconscious and instinctive muscular action following on sensation. The next stage in its development may be defined as unconscious and instinctive muscular action expressive of emotion. In this stage voice for the first time comes into play, and we recognise the howl of pain, the shriek of mortal terror, the growl or roar of anger and rage.

The second class of gestures—the gestures of will—being voluntary, are conscious, and only instinctive in so far as they express instinctive desires.

The third class is the result as well as the expression of thought, and under this head must also be classed the voluntary assumption of gestures belonging to the first class, for the purpose of deception. Thus an animal really frightened at the approach of an enemy will assume an expression of fierceness and anger, and ruffle his feathers or bristle up his hair to make himself look terrible; and a man with a flutter at his heart will, to use a common expression, "show a bold front." The third class, therefore, answers to a certain extent to that definition of language which says, "it was invented for purposes of concealment."

SUBTERRANEAN WOODS.

CLARENCE DEMING, in his "By-ways of Nature and Life," says of the swampy region of southern New Jersey:—

The huge trees which lie under the swamp to unknown depths are of the white cedar variety, an evergreen, known scientifically as the *Cupresses Thyoides*. They grew years ago in the fresh water, which is necessary for their sustenance, and when in time, either by a subsidence of the land or a rise of the seas, the salt water reached them, they died in numbers. But many of them, ere they died, fell over as living trees, and were covered slowly by the deposits of muck and peat which fill the swamp. Those trees that fell over by the roots, and known as "windfalls," to distinguish them from the "breakdowns," are the ones most sought for commercial uses, and they are found and worked as follows:—The log digger enters the swamp with a sharpened iron rod. He probes in the soft soil until he strikes a tree, probably two or three feet below the surface. In a few minutes he finds the length of the trunk, how much still remains firm wood, and at what place the first knots, which will stop the straight "split" necessary for shingles, begin. Still using his prod, like the divining-rod of a magician, he manages to secure a chip, and by the smell knows whether the tree is a windfall or breakdown. Then he inserts in the mud a saw like that used by ice-cutters, and saws through the roots and muck until the log is reached. The top and roots are thus sawed off, a ditch dug over the tree, the trunk loosened, and soon the great stick, sometimes five or six feet thick, rises and floats on the water, which quickly fills the ditch almost to the surface.

The log is now sawed into lengths 2 ft. long, which are split by hand and worked into shingles, as well as into staves used for pails and tubs. The wood has a coarse grain which splits as straight as an arrow. The shingles made from it last sixty or seventy years, are eagerly sought by builders in southern New Jersey, and command in the market a much higher price than ordinary shingles made of pine or chestnut, which last for roofing usually not more than twenty or twenty-five years. In colour the wood of the white cedar is a delicate pink, and it has a strong flavour, resembling that of the red cedar used in making lead pencils. The trees, once fairly buried in the swamp, never become waterlogged, as is shown by their floating in the ditches as soon as they are pried up, and what is more singular, as soon as they rise they turn invariably with their under sides uppermost. These two facts are mysteries which science has thus far left so. The men who dig the logs up and split them earn their money. The work, according to the *Industrial World*, is hard, requiring, besides lusty manual labour, skill and experience. The swamps are soft and treacherous, no machinery can be used, and long stretches with mud and water must be covered with boughs or bark before the shingles can reach the village and civilisation.

ON THE RAPID INCREASE OF SHORT SIGHT,

AND OTHER FORMS OF DEFECTIVE VISION.

By John Browning, F.R.A.S.

I WAS recently invited to attend a lecture at the Society of Arts, by Mr. Brudenell-Carter, "On the Influence of Civilisation upon Eyesight." The attention I have, for many years, given to subjects connected with vision, has made me acquainted with the fact generally that short sight is greatly on the increase; but I confess I was astonished at the statistics so ably put forward by the lecturer.

I pass over the lucid and interesting references to the evolution of the eye from a portion of the skin, owing to the action of light. We know that light must exert some special action on the body or it would not be so essential as it is to health.

Next, the lecturer dilated on the effect of transmission of short sight from parents, and in this connection I may say that I have supplied spectacles to four generations of one family for short sight within a few weeks, while for three generations I have many times supplied them. The evidence of transmission is in such cases undeniable. But, besides those cases which are thus unfortunately and inevitably increasing, we are manufacturing short-sighted people on wholesale scale. Mr. Brudenell-Carter has done excellent work in directing attention to this subject in his well-known manual on "Eyesight, Good and Bad."

Some seventy years since, in three regiments of Guards, tested for defective vision, short sight was almost entirely unknown; and only last year, an examination of the children of a Board School in South London, showed that more than one-fourth of the children had defective vision, and one in each ten was shortsighted. Mr. Brudenell-Carter recently wrote to the London School Board, and offered to test the eyesight of a large number of the scholars, but his offer was unceremoniously declined, in an uncivil letter, in very bad English. The President of the evening, Dr. Mann, more than hinted that this proved that civilisation might produce cerebral degeneration as well as defective vision. Perhaps I may be pardoned for saying that the refusal proved that the majority of the School Board consisted of shortsighted persons.

In every other respect but that of vision our race is improving. That the stature of our men is increasing, and that our athletes even out-do the picked men of savage races, and even the feats that were performed in rowing,

XUM

running, and swimming by their forefathers a few years ago, is perfectly well known, but few of them could bear any comparison with a savage as regards keenness of vision at a distance.

The President stated that Mr. Francis Cobb recollected an instance, when he was in Africa, of a friend directing attention to a small speck that he saw at a great distance, which he thought was moving. On pointing this out to some natives who were with them, they at once pronounced it to be the missionary, who was on foot, and his wife who was on horseback, and mentioned who they were. Having obtained a good binocular, Mr. Cobb was able to see that the natives were correct—that there were two persons—but he could not, even with the binocular, tell one was riding, nor who they were.

The lecturer explained that deterioration of our powers of vision is due to two causes:—concentrating our attention almost exclusively on near objects—as in reading, drawing, needlework, &c.; and never using our eyes for any length of time in examining objects at a distance. He particularly denounced small-type schoolbooks as most destructive of the sight, especially for very young children, and then pointed out the best method of preventing further mischief and of improving the vision.

All schoolbooks should be printed in large type, and the earliest books should be in type of the size used in printing the texts hung in the waiting-rooms at railway-stations.

Lessons should be given on the black-board, and pupils should be encouraged to describe objects at a distance.

Parents should choose for their children who show a tendency to shortsightedness, out-door occupations and amusements.

Prizes should be given at schools and athletic meetings to those who can accurately describe objects with which they are unacquainted at the greatest distance.

It would be difficult to overrate the value of this subject and these suggestions. People who are short-sighted cannot observe natural objects at a distance; their attention is confined to their immediate surroundings. They must, therefore, be deficient in many kinds of knowledge compared with those who are more favourably circumstanced as regards vision.

It is not possible, without risking great injury to their eyesight, to give short-sighted persons the same clear-vision for a distance that is enjoyed by persons who have normal vision, and, as Mr. Brudenell-Carter observed, *all those persons who are very short-sighted, are on the threshold of disease of the eye.*

In the discussion which followed Mr. Brudenell-Carter's paper, I drew his attention to the great difficulty I often experienced in getting many persons suffering from short sight to wear spectacles. He made me this wise and witty reply: "With regard to the unwillingness of short-sighted persons to wear spectacles, he would mention an argument he always used to the mothers of young ladies, which he found extremely potent. He said, unless you make the girl grow up in spectacles, in the first place, she will never see the expressions of the human face; next, she will never obtain the power of estimating character, and then she will make a foolish marriage. He generally found that even the most prejudiced were convinced by that argument."

Mr. Brudenell-Carter has performed a national service in bringing this important subject so prominently before the public.

The extent to which short-sighted persons go on increasing their calamity is almost beyond belief. A great number of them wear only a single pair of spectacles, with which they cannot see well either near or distant objects, instead of having one pair of spectacles to read with and another for walking in, that is, for general out-door use, as they should have. Others, again, content with the fact that they can see any object plainly if they hold it within five or six inches from the face, never wear any kind of glasses, but hold up occasionally a single eye-glass or pair of spring folders, far too strong for them when they require to see any distance. Such a course of proceeding is usually attended with disastrous results to the eyesight.

It would require more space than I have at my disposal to indicate the incalculable mischief done in cases of short sight by persons who know next to nothing about their own eyes, purchasing spectacles from those who know still less. Unfortunately there are few opticians, indeed, who are competent to assist the vision in cases of short sight: until they understand both the eye and optics better, and give their advice as a surgeon or physician would, with a single-minded desire to preserve the eyesight of those who apply to them for assistance, without regard to the profit that can be made by selling their spectacles, defective vision must increase.

RAMBLES WITH A HAMMER.

By W. Jerome Harrison, F.G.S.

IN SOUTH LEICESTERSHIRE.

THE slaty rocks of Charnwood Forest occupy the north-western part of Leicestershire. It is probable that they are as old as any rocks exposed in England or Wales, their formation dating back to Pre-Cambrian times. These ancient rocks dip to the south and to the east, passing underneath red marls and sandstones of Triassic age, which form the greater part of the south and south-west of the county of Leicester. These red rocks often have a banded appearance, lines of buff or drab alternating with the red beds which constitute the mass of the formation. The uppermost division of the Trias is known as the *Keuper*, because in Germany ores of copper (*Kupfer*) are found in beds of this age. Sections of the Keuper Red Marls are well seen in many of the cuttings of the Midland Railway north of Leicester, as at Syston (where the red beds are traversed by veins of gypsum) and between Loughborough and Trent Bridge. The uppermost red marls with gypsum bands are finely shown in the brick-pits at the foot of the Spinney Hills, an eastern suburb of Leicester. Included in the marls is an irregular sandy bed, called the Upper Keuper Sandstone, about thirty feet in thickness. It is well exposed in the Dane Hills, a low ridge which crosses the Hinckley road, a mile-and-a-half west of Leicester. All the strata of Triassic age—all which occur in England, at all events—appear to have been deposited in an inland sea of considerable extent, whose waters were almost constantly saturated with common salt and with oxide of iron. To a small percentage of the latter substance the red colour of the beds is due, while the former compound is now the source of the great supplies of rock-salt and of brine which are obtained from the Trias of Cheshire and Worcestershire. Evidence of the presence of an excess of common salt in the waters of the sea which then covered Leicestershire and all central England is afforded by the existence of numerous *pseudomorphs* of salt in the red marl. These were once cubical salt crystals, but water percolating through the rocks has removed the salt—molecule by molecule—and replaced it by marl, so that we now have perfect reproductions, in hard marl, of the original crystals. Such pseudomorphs are common on the blocks of grey marl in the Spinney Hill pits, and, indeed, may be found wherever the upper red marls are exposed. They are best seen on slabs that have been exposed for some time to the weather.

The pseudomorphs—being harder than the surrounding clay—then stand out boldly on the weathered surfaces. No fossils occur in the Triassic marls, and we are not surprised at their absence, when we consider the impure state of the water—inimical to life—in which these marls were deposited, under conditions analogous to those which now prevail in the Dead Sea, Lake Utah, &c. But the Keuper sandstones afford a scanty fauna. From the old ballast-cutting in this sandstone, in the Dane Hills, I obtained numerous specimens of a little crustacean — *Estheria*— whose carapaces (all that remain) are exactly like a little furrowed shell, together with some good fish-spines.

The average thickness of the "red rocks" of South Leicestershire is from 500 to 700 feet, and they cover over with their undulations both the old slates of Charnwood, and the softer shales, with their inter-bedded coal-seams, which form the eastern half of the Leicestershire coal-field, and which are reached by shafts through the red marls at Whitwick, Bagworth, Nailston, Ellistown, &c. Roughly speaking, the River Soar forms the eastern boundary of the Trias; for along the general line of its course from south to north the red marls disappear beneath the stiff clays of the Lower Lias, which form the famous grass-lands and hunting-fields of East Leicestershire.

The Triassic marls dip to the east, and above them come the Rhaetic beds, about forty feet in thickness; they consist of black and blue shales containing numerous fossils. They mark a change in the condition of things, due probably to a depression of the land-border of the Triassic lake by which the waters of the exterior seas were allowed to enter, bringing with them new and numerous forms of life. These Rhaetic beds cap the Spinney Hills, being well exposed in the brick-pits near St. Saviour's Church. I described their occurrence here in the "Journal of the Geological Society" for 1873, and my search in the shales was rewarded by many fossils, especially a rare and beautiful starfish then found for the first time in these beds. The visitor who walks eastward from the Leicester (Midland) station can examine within less than a mile both the Triassic and Rhaetic sections of the Spinney Hills. If he continues his walk for a mile-and-a-half in the same direction, he will find, on Crown Hill, some good sections of the Lower Lias Limestones and Shales, which rest upon the Rhaetic beds, forming the low hills between Leicester and the village of Evington.

There is an excellent section of the entire thickness (40 ft.) of the Rhaetics in the brick-works close to the new railway station (L. & N.-W.) at Glen Parva, four miles south of Leicester.

(To be continued).

FORMS OF LEAVES.

A LECTURE

BY SIR JOHN LUBBOCK, BART., M.P., D.C.L., LL.D., F.R.S., &c.

GREATLY as we all appreciate the exquisite loveliness of flowers, it must be admitted that the beauty of our woods and fields was even more due to the marvellous grace and infinite variety of foliage. How is this inexhaustible richness of forms to be accounted for? Does it result from an innate tendency of the leaves in each species to assume some particular shape? Has it been intentionally designed to delight the eyes of man? or has it reference to the structure and organisation, the wants and requirements of the plant itself?

Now, if we consider, firstly, the size of the leaf, we shall find that it is regulated mainly with reference to the thickness of the stem, and that, when strict proportion is departed from, the difference can generally be accounted for. This was shown, for instance, by a table giving the leaf area and the diameter of stem of the hornbeam, beech, elm, lime, Spanish chestnut, ash, walnut, and horse-chestnut.

The size once determined exercises much influence on the form. For instance, in the beech the leaf has an area of about three square inches. The distance between the buds is about $1\frac{1}{4}$ in., and the leaves lie in the general plane of the branch, which bends slightly at each internode. The basal half of the leaf fits the swell of the twig, while the upper half follows the edge of the leaf above; and the form of the inner edge being thus determined, decides that of the outer one also. In the lime the internodes are longer and the leaf consequently broader. In the Spanish chestnut the stem is nearly three times as stout as that of the beech, and, consequently, can carry a larger leaf surface. But the distances between the buds are often little greater than those in the beech. This determines, then, the width, and, by compelling the leaf to lengthen itself, leads to the peculiar form which it assumes. Moreover, not only do the leaves on a single twig admirably fit one another, but they are also adopted to the ramification of the twigs themselves, and thus avail themselves of the light and air, as we can see by the shade they cast without large interspaces or much over-lapping. In the sycamores, maples, and horse-chestnuts, the arrangement is altogether different. The shoots are stiff and upright, with leaves placed at right angles to the plane of the branch instead of being parallel to it. The leaves are in pairs and decussate with one another, while the lower ones have long petioles which bring them almost to the level of the upper pairs; the whole thus forming a beautiful dome.

For leaves arranged as in the beech, the gentle swell at the base is admirably suited; but in a crown of leaves, such as those of the sycamore, space would be thereby wasted, and it is better that they should expand at once, as soon as their stalks have carried them free from the upper and inner leaves. Hence, we see how beautifully the whole form of these leaves is adapted to the mode of growth of, and arrangement of, the buds in the plants themselves.

In the black poplar the arrangement of the leaves is again quite different. The leaf stalk is flattened, so that the leaves hang vertically. In connection with this, it will be observed that while in most leaves the upper and under surfaces are quite unlike, in the black poplar, on the contrary, they are very similar. The stomata, or breathing-holes, moreover, which in the leaves of most trees are confined to the under surface, are in this species nearly equally numerous on both. The "compass" plant of the American prairies—a yellow composite, not unlike a small sunflower—is another plant with upright leaves, which, growing in the wide open prairies, tend to point north and south, thus exposing both surfaces equally to the light and heat. It was shown by diagrams that this position also affected the internal structure of the leaf.

In the yew the leaves are inserted close to one another, and are long and linear, while in the box they are further apart and broader. In the Scotch fir the leaves are linear and $1\frac{1}{2}$ in. long, while in other pines—as for instance, the Weymouth—the stem is thicker and the leaves longer.

In the plants hitherto mentioned, one main consideration appears to be the securing of as much light as possible; but in tropical countries the sun is often too powerful, and the leaves, far from courting, avoid the light. The typical acacias have primate leaves, but in most Australian species the true leaves are replaced by a vertically flattened leaf-stalk. It will be found, however, that the seedlings have leaves of the form typical in the genus. Gradually, how-

ever, the leaf becomes smaller and smaller, until nothing is left but the flattened leaf-stalk or phyllode. In one species the plant throughout life produces both leaves and phyllodes, which gives it a very curious and interesting appearance. In eucalyptus, again, the young plant has horizontal leaves, which in older ones are replaced by scimitar-shaped phyllodes. Hence the different appearance of the young and old trees, which must have struck every visitor to Algiers or the Riviera.

(To be continued.)

THE FACE OF THE SKY.

From Feb. 27 to March 13.

By F.R.A.S.

THE Sun, who is daily rising higher above the mists of the horizon, should be examined for spots and faculæ whenever the sky is clear. Map III. of "The Stars in their Seasons" portrays the face of the Night Sky. Mercury is very badly placed indeed for the observer, for he is travelling, as it were, behind the Sun—a remark which applies almost equally to Venus, who, though, does not come into superior conjunction, as he does during the next fortnight. Mars is quite invisible, as is Neptune too now; Jupiter is, *par excellence, the* object in the Night Sky now, and is practically visible all night long. During the time covered by these notes he will be travelling towards, and in a direction slightly above, Regulus, or α Leonis (the "Stars in their Seasons," Map IV.), to which he will be very close towards the end of the next fourteen days. The phenomena of his Satellites will present a series of the most interesting spectacles to the observer during that period. Beginning with to-night, the transit of Satellite I. may possibly be seen to begin at 6h. 16m. p.m., followed by its shadow at 6h. 28m. The Satellite leaves Jupiter's opposite limb at 8h. 35m.; the shadow at 8h. 48m. Then at 9h. 38m. Satellite IV. will enter on to Jupiter's face, and its transit should be carefully watched to see whether the Satellite appears light or dark on the disc of the planet; whether it changes from light to dark—or what. Its shadow does not enter on to the limb of Jupiter until 11h. 34m., and it is not until more than two and four hours after midnight that the Satellite and the shadow respectively complete their transits. At 5h. 54m. 57s. p.m. on the 28th perhaps Satellite I. may be seen to reappear from eclipse. Satellite II. will be occulted at 8h. 48m., to reappear from eclipse 10m. 5s. after midnight. On March 2, the egress of Satellite II. happens in twilight at 5h. 53m.; its shadow following it off Jupiter's face at 6h. 27m. p m. On the 5th, Satellite I. will be occulted at 10h. 42m. p m. On the 6th, Satellite III. passes off the limb of the planet at 7h. 19m. p.m. The transit of Satellite I. begins at 8 o'clock, and that of its shadow at 8h. 23m. Then at 8h. 50m. the shadow of Satellite III. follows the Satellite casting it, off Jupiter. The egress of Satellite I. occurs at 10h. 20m.; that of its shadow at 10h. 42m. On the 7th, Satellite I. reappears from eclipse at 7h. 49m. 4s., and Satellite II. is occulted at 11h. 4m. p.m. On the 9th, the ingress of the shadow of Satellite II. happens at 6h. 6m. p.m., but its visibility is doubtful. Satellite II. itself leaves the opposite limb at 8h. 8m.; as does its shadow at 9h. 2m. On the 12th, Satellite I. will be occulted 27 minutes after midnight. Finally, on the 13th, a transit of Satellite III. will happen, which should be carefully watched throughout. At 7h. 1m. p.m. the ingress of this Satellite occurs, as does that of its shadow at 9h. 11m. The transit of Satellite I. begins at 9h. 45m.; its shadow following it at 10h. 17m. The egress of Satellite III. takes place at 10h. 39m.; the egress of Satellite I. at 12h. 5m.; that of its shadow at 12h. 37m.; while, lastly, 49 minutes after midnight, the egress of the shadow of Satellite III. will leave the face of the planet quite clear. Saturn is approaching the west, and the observer who wishes so see him now must direct his telescope towards the ringed planet as soon as ever it is dark. He continues to form a rudely isosceles triangle with β and ζ Tauri (the "Stars in their Seasons," Map. I). Uranus is now coming into a very good position for observation, and may be seen with the naked eye to the west of η Virginis by any one who knows exactly where to look for him. His pale greenish planetary disc in the telescope renders him identifiable at once. The Moon is full at 4h. 0·4m. a.m., on March 1; and enters her last quarter at 6h. 54·1m. p.m. on the 8th. Two occultations only occur in the next fortnight, during the hours terminating at 1 a.m. The first is of the 6th mag. star, 25 Sextantis, which, on February 28, will disappear at what looks like the bright limb of the moon at 11h. 59m. p.m., at an angle from her vertex of 38°, reappearing at her opposite bright limb at 1h. 4m. a.m., at an angle of 287° from her vertex. The second occultation happens on March 6, when θ Libra, a star of the 4½ magnitude disappears at the Moon's bright limb at 12h. 52m. at a vertical angle of 30°, and reappears at the dark limb at 2h. 2m. a.m. at an angle of 240° from her vertex. When these notes begin, the Moon is on the very confines of Cancer and Leo, passing into this latter constellation before 1 o'clock this afternoon. She is travelling through Leo until 6h. p.m. on the 23rd, when she descends into Sextans; but she re-emerges into Leo at 3h. a.m. on March 1, and does not finally quit it for Virgo until 2h. a.m. on the 2nd. Her journey through this great constellation occupies her until 6h. a.m. on the 5th, and then she crosses into Libra. Forty-eight hours later (*i.e.*, at 6h. a.m. on the 7th) she arrives at the boundary of the narrow northern strip of Scorpio, which she takes until 5 o'clock the same afternoon to traverse, and move into the southern part of Ophiuchus. She takes until 3h. p.m. on the 9th to cross this and enter Sagittarius, from which, at 5 a.m. on the 12th, she passes into Capricornus. At midnight she quits this for Aquarius, across which she is travelling when these notes terminate.

FIRST STAR LESSONS.

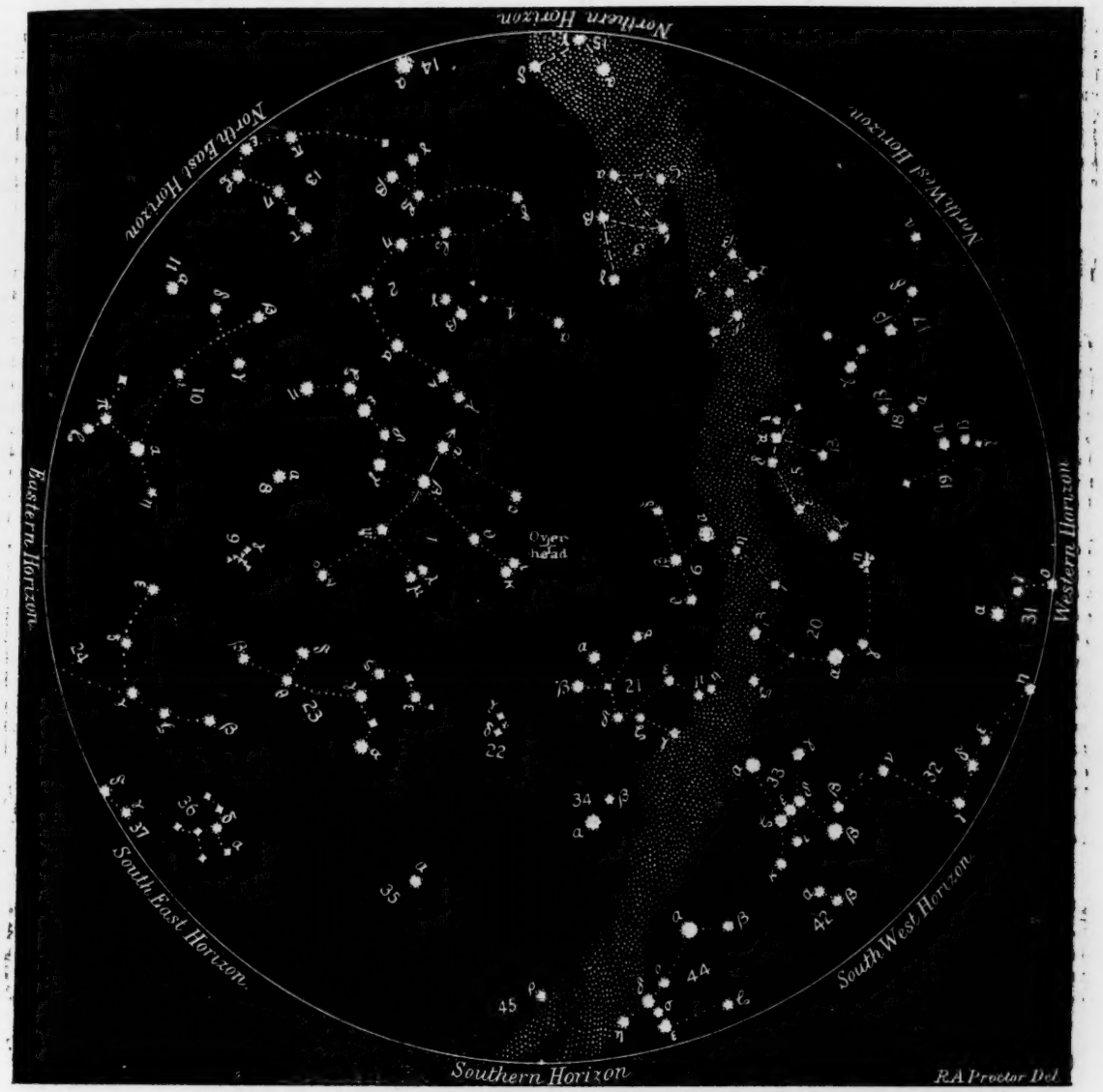
By Richard A. Proctor.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct) :—

1. *Ursa Minor*, the *Little Bear* (α, the *Pole Star*).
2. *Draco*, the *Dragon* (α, *Thuban*)
3. *Cepheus*, *King Cepheus.*
4. *Cassiopeia*, the *Lady in the Chair.*
5. *Perseus*, the *Champion* (β, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (α, *Capella*)
7. *Ursa Major*, the *Greater Bear* (α, β, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (α, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair.*
10. *Boötes*, the *Herdsman* (α, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown.*
12. *Serpens*, the *Serpent.*
13. *Hercules*, the *Kneeler.*
14. *Lyra*, the *Lyre* (α, *Vega*).
15. *Cygnus*, the *Swan* (α, *Arided*; β, *Albires*).
16. *Pegasus*, the *Winged Horse.*
17. *Andromeda*, the *Chained Lady.*
18. *Triangula*, the *Triangles.*
19. *Aries*, the *Ram.*
20. *Taurus*, the *Bull* (α, *Aldeburan*; η, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (α, *Castor*; β, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (α, *Regulus*).
24. *Virgo*, the *Virgin* (α, *Spica*)
25. *Libra*, the *Scales.*
26. *Ophiuchus*, the *Serpent Holder.*
27. *Aquila*, the *Eagle* (α, *Altair*).
28. *Delphinus*, the *Dolphin.*
29. *Aquarius*, the *Water Carrier.*
30. *Pisces*, the *Fishes.*
31. *Cetus*, the *Sea Monster* (o, *Mira*, remarkable variable).
32. *Eridanus*, the *River.*
33. *Orion*, the *Giant Hunter* (α, *Betelgeux*; β, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (α, *Procyon*).
35. *Hydra*, the *Sea Serpent* (α, *Alphard*).
36. *Crater*, the *Cup* (α, *Alkes*).
37. *Corvus*, the *Crow.*
38. *Scorpio*, the *Scorpion* (α, *Antares*).
39. *Sagittarius*, the *Archer.*
40. *Capricornus*, the *Sea Goat.*
41. *Piscis Australis*, the *Southern Fish* (α, *Fomalhaut*).
42. *Lepus*, the *Hare.*
43. *Columba*, the *Dove.*
44. *Canis Major*, the *Greater Dog* (α, *Sirius*).
45. *Argo*, the *Ship.*

Note.—The *description* of the map given in Knowledge for February 13 applies to the present map, with very slight change. It was not thought necessary to repeat it.

We learn that the Revised Version of the Bible is at length completed, and that it will be published shortly after Easter simultaneously by Mr. Frowde and by Messrs. Clay & Son.



NIGHT SKY FOR FEBRUARY (Second Map of Pair),

Showing the heavens as they appear at the following hours:—

February 21 at 10 o'clock.	March 5 at 9¼ o'clock.	March 16 at 8¼ o'clock.
February 25 at 9⅔ o'clock.	March 8 at 9 o'clock.	March 20 at 8¼ o'clock.
March 1 at 9¼ o'clock.	March 12 at 8¾ o'clock.	March 23 at 8 o'clock.

Editorial Gossip.

Astronomers anxious to distinguish themselves in prize competitions may be interested in knowing that (in the familiar words of the advertisements) "an eligible opportunity now offers." Mr. H. H. Warner, the founder of the Warner Observatory, Rochester, New York, offers:—"First, two hundred dollars for each and every discovery of a new comet made from February 1st, 1885, to February 1st, 1886, subject to the following conditions: 1. It must be discovered in the United States, Canada, Mexico, West Indies, South America, Great Britain and the Australian Continent and Islands, either by the naked eye or telescope, and it must be unexpected, except as to the comet of 1815, which is expected to reappear this year or next. 2. The discoverer must send a prepaid telegram immediately to Dr. Lewis Swift, Director Warner Observatory, Rochester, N.Y., giving the time of the discovery, the position and direction of motion with sufficient exactness, if possible, to enable at least one other observer to find it. 3. This intelligence must not be communicated to any other party or parties, either by letter, telegraph, or otherwise, until such time as

a telegraphic acknowledgment has been received by the discoverer from Dr. Swift. Great care should be observed regarding this condition, as it is essential to the proper transmission of the discovery, with the name of the discoverer, to the various parts of the world, which will be immediately made by Dr. Swift. Discoverers in Great Britain, the Australian Continent and Islands, West Indies, and South America are absolved from the restriction in conditions 2nd and 3rd." Distinction, and £40, then, await alike the possessor of anything from a 3-inch "Bateman" up to an 18-inch "Calver," or even an opera-glass, who can and will during the next twelve months pick up one of these erratic intruders into our system.

But this is not all. Mr. Warner proceeds to offer a "Second prize of $200 in gold to any person in the world who will write the best 3,000 word paper on the cause of the atmospheric effects ['red light,' &c.] accompanying sunset and sunrise during the past sixteen months. It is desired that these papers be as original as possible, both in facts, observations, and treatment. Essays must be exclusively sent prepaid to Dr. Lewis Swift, Director Warner Observatory, Rochester, New York, must be written in English, on one side of paper only, with ink, and must be in the simplest, untechnical phrase. Each competitor must sign a *nom de plume* to his essay, and enclose his real name and address in an envelope, superscribed with his *nom de plume*. The essays must be in Dr. Swift's hands by Dec. 1, 1885. Three disinterested scientists will be selected to determine the result, and also to settle any dispute that may arise regarding comet discoveries." This really looks like a covert intimation that the explanation (?) of the wonderful fore and after-glows, which have at once astonished and delighted observers in all parts of the world during the last three years, given by the little Krakatoa Committee at Brompton, had explained nothing, and that the source of this strange phenomenon has still to be detected.

Reading as I do in *L'Illustrite Zeitung* how the after-glow in Berlin on Jan. 26 was quite equal in intensity and beauty to anything seen last year, I am almost tempted to ask whether this strangely-persistent apparition may not really have a cosmical origin, and not a merely terrestrial one at all.

Here is another chance of quasi-astronomical distinction. M. Palisa, who has spent so much time (which might have been more profitably employed) in adding to the number of known pocket-planets between Mars and Jupiter, is desirous of organising an expedition to observe the solar eclipse of Aug. 29, 1886; and, to aid in raising the necessary funds, offers to sell, for 1,250 f., the right of naming the Planetoid No. 244! Now, gentlemen; who wishes to gain immortality, at the almost nominal rate of £50, by the inscription of his name in the sky? Don't all speak at once.

A very remarkable illustration of the intimate connection between the mind and the body reaches me from Staffordshire, where at Hanley a certain so-called "Major" Pearson, of the "Salvation Army," is stated to be working cures on the blind, the deaf, and the lame. Rubbing and praying seem to be the immediately operative agencies in (what are alleged to be) the cures effected. "A lad," we read, "who had been a cripple from an early age . . . was induced to rise and walk about a little. Further, we learn that "an old woman, who represented that she had been deaf for forty years, stated that she had regained her hearing; and a young woman, who went into the building stone deaf, testified to her cure. Another young woman, a confirmed invalid, who was taken to the Circus in a bath-chair, was prayed for, and finally staggered to her feet and walked a yard or two, and a few moments afterwards another woman walked feebly across the building, her bath-chair being hoisted over the heads of the people. Several persons ascended the platform and publicly testified to their cure, and the congregation joined in thanksgiving for these recoveries."

Now, allowing for a certain amount of inevitable exaggeration in such a report as this, it is abundantly evident that well-marked physical effects did supervene as an immediate result of this mountebank nonsense; and that what Dr. Carpenter has called "expectant attention" produced more or less remarkable results on sick and suffering people. That the phenomena, curious as they were, were wholly and solely subjective, no sane person possessing the merest smattering of psychology and pathology can for an instant doubt. Not so very many generations have passed, though, since they would have been regarded as actual miracles, wrought by aid either from above or beneath, and the "Major" performing them would have been either canonised or cremated.

The mathematical astronomer will find much to interest him in an essay by Professor Simon Newcomb, "On the Motion of Hyperion (the seventh satellite of Saturn). A New Case in Celestial Mechanics," which has recently been issued by the Bureau of Navigation, at Washington; in other words from the office of the American *Nautical Almanac*. Hyperion is the outermost satellite but one of Saturn, and the last discovered. Immediately within its eccentric orbit lies the nearly circular one of the largest of all the satellites, Titan, and it is the disturbing effect of this body upon Hyperion which gives rise to the abnormal phenomenon which Professor Newcomb very beautifully explains. According to the law of gravitation, when a body moving in an eccentric orbit is disturbed by another travelling in a nearly circular one, the secular motion of the peri-centre will always be direct. In the case of Hyperion, however, its peri-Saturnium actually revolves in a retrograde direction in eighteen years or thereabouts; which at first sight looks as though the law of gravitation had here broken down. How, though, this is really absolutely in accordance with that law, and has its origin in a relation between the mean longitudes of the two satellites, the reader must go to the paper itself to discover. I must, however, add that, save to those versed in the higher mathematics, Mr. Newcomb's essay will surely be unintelligible. As far as the student of ordinary popular science is concerned it might be written in Tamil or provincial Dongolese. An even more abstruse paper on "Lunar Irregularities due to the Ellipticity of the Earth," by Mr. G. W. Hill, accompanies it.

No better evidence of the wide diffusion of a taste for scientific knowledge could be found, than that afforded by the fact that the *Standard* of Thursday week contained a leading article on the Occultation of Aldebaran, which happened on Sunday evening last. That the principal London daily newspaper should devote a column of its most valuable space to an essay—and by the way, an admirably well written essay, too—on so technical an astronomical subject as this, only shows the enormous growth of a public interest in science. Let us hope that it stimulated apathetic observers; and so bore fruit in more than one direction.

Unhappily, the detestable weather wholly prevented the observation of this interesting phenomenon in the south of England.

From a Sussex newspaper, which some one has been good enough to send me, I learn that three mad dogs have recently appeared in various parts of that county. One in Lewes, the county town, which bit several children; one at Crawley, a station on the Brighton line, which confined its attentions to its own species; and a third at a place called Nutley (which appears from the map to be a village on the high road from London to Lewes through East Grinstead), and which bit two children and several dogs. This last brute seems to have been shot, the two former ones to be still at large. I mention this here as showing the baselessness of the old superstition, that hydrophobia only appears during the so-called "Dog-days," which last from July 3rd to August 11th.

Reviews.

SOME BOOKS ON OUR TABLE.

Louis Pasteur: His Life and Labours. By his Son-in-Law. Translated from the French by Lady Claud Hamilton. (London: Longmans, Green, & Co., 1885.)—Were the question asked, Who during the present generation has made the most valuable contributions to the science of pathology, and to whom are we most indebted for our knowledge of the source of divers fell diseases, concerning which we were, prior to his researches, in the most profound ignorance? there could be but one answer. Louis Pasteur, the subject of the memoir before us. For, as says Professor Tyndall in the introduction which he has written to this English edition of M. Radot's volume, "In the investigation of microscopic organisms . . . . M. Pasteur has found his true vocation. In this broad field it has been his good fortune to alight upon a crowd of connected problems of the highest public and scientific interest, ripe for solution, and requiring for their successful treatment the precise culture and capacities which he has brought to bear upon them." More than forty years ago, it was noticed that tartaric acid and paratartaric acid acted differently on polarised light, and, as these substances had the same chemical composition, the same specific weight, the same double refraction, and as no difference in their crystalline form had been detected, the fact that, while one caused the plane of polarisation to rotate, the other was inert, was a profound puzzle. It was solved by Pasteur (then a young man in the École Normale), showing that while the crystalline form of tartaric acid was asymmetrical, paratartaric acid in the form of crystals presented perfect symmetry. As a generalisation from numerous beautiful experiments which followed this discovery he enunciated the broad principle that dissymmetry is the characteristic of organic nature; symmetry, that of the inorganic world. Wide, and probably fruitful though, as was the field of research in molecular optics thus opened, it was in a very different one that Pasteur was to win a name that is now honoured in every part of the world in which the mystery of contagion has been studied. In his investigation of the phenomena presented by the two salts of which we have spoken, he discovered the startling fact that a ferment had the power of causing left-handed polarisation in the previously inert paratartrate of ammonia, and from this to the study of ferments in general was not a very difficult or unnatural step. How he showed that fermentation has its origin in the rapid growth of microscopic organisms; how he explained the manner in which vinegar is produced from wine, and whence the "diseases" to which wine and beer are subject arise, the reader must go to the book itself to learn; as he must for the details of the exhaustive experiments by the aid of which Pasteur demolished the doctrine of spontaneous generation. Subsequently, we find this indefatigable inquirer successively and successfully searching for the causes of the silk-worm disease, splenic fever, septicæmia, chicken cholera, &c., and showing how the special virus (a microscopic organism peculiar to each disease) could be cultivated for the purpose of vaccination, so as to afford the vaccinated creature immunity from future attacks. As we write, Pasteur is still engaged in the investigation of hydrophobia and its cause. Should he discover the means of cultivating the active principle in this most awful of all disorders, he will crown an imperishable series of labours in the cause of humanity. A word as to the English form in which the record of his labours appears. There is not one dry page in it from beginning to end. The charm of the colloquial French in which the original is written has not evaporated in Lady Claud Hamilton's spirited and faithful translation. Professor Tyndall has furnished an introduction which is, like everything he ever writes, eminently readable; and, in short, while the book is as interesting as the best novel of the season, it differs from the most cleverly-written tale in possessing an interest that is not merely ephemeral, but perennial.

The Collector's Manual of British Land and Fresh-water Shells. By Lionel Ernest Adams, B.A. (London: George Bell & Sons, 1884).—The incipient conchologist may be grateful to Mr. Adams for having furnished him with one of the best and most intelligible manuals in a moderate compass on our British land and freshwater shells that have, so far, appeared. One distinguishing excellence of the work before us lies in the plainness and intelligibility of the author's descriptions; all technical terms being explained by reference to capitally-executed engravings. In fact, the very numerous illustrations themselves should enable the beginner to identify every common shell found in these islands. In these days of species-making, the student but too often gets horribly puzzled in vain efforts to detect what are (to him) but obscure distinctions, indeed, between the specimens he collects; and here he will find Mr. Adams's plainly-worded descriptions most helpful. In an equally good introduction the methods of collecting, preserving, and arranging shells are fully treated of.

The Journal of Microscopy and Natural Science. Published quarterly. January 1885. (London: Baillière, Tindall, & Cox.) *Studies in Microscopical Science.* (London: Watson & Sons).—We class these works together, indicating as they do, each in its way, a happily growing popular interest in microscopical study. What the "Journal of the Royal Microscopical Society" (crowded as it is with matter and bristling with technicalities) does for the advanced microscopist, the "Journal of Microscopy" essays to do—and we may say at once succeeds well in doing—for the less pretentious student. It is the organ of the Postal Microscopical Society; as the more pretentious volume is of the R.M.S. As indicating the variety it affords its readers, we may mention that it contains the presidential address of the P.M.S., a paper on "The Inhabitants and Guests of a Piece of Hornwrack," "Rambles of a Naturalist near Amberley," "The Microscope and How to Use It" (capital for beginners); a profusely illustrated essay, "Half an Hour with the Microscope," by Mr. Tuffen West; Selected Notes from the Society's Note-book, Report of the P.M.S. Annual Meeting, reviews, &c. The very book for the man who employs his microscope as a means of recreation.

The "Studies in Microscopical Science," edited by Mr. Cole, are issued in a pamphlet form, either with or without slides of preparations; but in either case containing coloured lithographic plates of the objects to which the descriptions refer. The value of such a mode of instruction for the student need scarcely be insisted on here.

John Bull to Max O'Rell. (London: Wyman & Sons.)—When "A Brutal Saxon" (whose work we reviewed on p. 75 of our last volume) essayed to answer Mr. "Max O'Rell," he mainly adopted the *tu quoque* style of argument, and showed, conclusively enough, that certain vices and failings of which Mr. O'Rell accused the English existed in an aggravated and intensified form in Paris. "John Bull" is much more argumentative, taking the Frenchman's allegations *seriatim*, and showing how utterly baseless a large proportion of them are. In his peroration the author rises almost to eloquence.

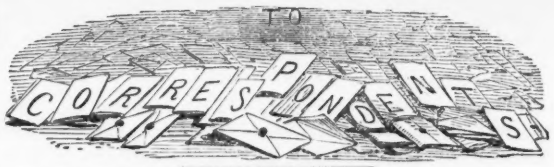
A Handbook of the Geology of Shropshire. By Rev. J. D. La Touche. (London: E. Stanford. 1884.)—The student of the Palæozoic and Mesozoic strata in England, with their wealth of contained fossils, will find a fruitful field of investigation in Shropshire, in which every formation from the pre-Cambrian rocks up to the Lias are represented. And it would be hard to find a more useful and practical guide than that provided by Mr. La Touche in the volume before us. Commencing with a minute topographical description of the occurrence of the various strata in Salop, he goes on to give an exhaustive account of the numerous and various fossils found in them, the very closely-packed figures which illustrate such account occupying 22 plates! This is a work simply indispensable to every geologist engaged in the study or examination of the district to which it relates.

Practical Hints on House Drainage. By A Clerk of the Works. (London: A. Boot & Sons).—This little pamphlet is eminently practical, and may well be studied by every householder, inasmuch as the amount of really preventible disease which is produced by imperfect drainage is absolutely appalling. How ordinary "traps" are so in a double sense the "Clerk of the Works" conclusively shows, at the same time pointing out the remedy. He instructs us how to test drain-pipes, advocates "inspection pipes" for cleansing purposes, and in fact gives simple and intelligible directions for rendering drains at once efficient and innocuous.

Deaconess House, Carlsruhe: Hints on Village Nursing. By E. A. E. (London: Francis Hodgson, 1885.)—The authoress of this *brochure* was laid up last September with an inflamed foot in Carlsruhe, and entered the Deaconess House then as a first-class patient, remaining until her recovery, which happened at the end of a month. The experience she gained of the inner working of this establishment impressed her with the idea that similar institutions in this country would afford valuable training for nurses, and do good in other ways. Details of the scheme will be found in this pamphlet, which contains many useful hints.

The Lunacy Law; its Defects, and a Scheme of Reform. By William R. Huggard, M.A., M.D. (London: British Medical Association.)—Dr. Huggard's sensible and practical little pamphlet deals with the admitted defects in the existing lunacy law, and contains suggestions for their improvement. We are entirely with him save on the question of private asylums, which he would suffer to continue under increased rigidity of supervision. We would absolutely and entirely abolish them.

We have also on our table *Society, Medical Press and Circular, Bradstreet's, Naturen, The Tricyclist, Wheeling, Ciel et Terre, Proceedings of the Geological Society.*



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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EVOLUTION *VERSUS* NATURAL SELECTION.

[1610]—Will you kindly allow me to put my question (cross-question) more clearly than it appeared in your Short Answers? Like all the master's readers, I love as much as honour the master; yet I have never been able not to suspect his doctrine—namely, that evolution is the result of natural selection. Is not evolution much rather the cause, not consequence, and natural selection (even where operative) quite subordinate, a *modus operandi aut procedendi?*

My question is this, by way of crucial example, "Is it in the least reasonable to suppose that the male organ was "acquired" by natural selection, one low animal once happening to "vary" ("variation" is a bad word: development is not variation, but reason's growth) into the rudiments of it, and thereby obtaining an advantage over his asexual or hermaphrodite rivals in the struggle for existence and for the female and for offspring?

Surely, the arcanal reason and origin of bi-sex lay in the nature of the case, in that inner necessity (*innere Nothwendigkeit*) that predistined reason (*die reine Vernunft*) which is in, which is, the universe—the *I am*, and which rules the organic as much as the inorganic world. This is "the cause, the cause of soul," though we cannot comprehend it. Commentator.

"THE BEGINNING OF THE MIND AND THE END OF THE MATTER."

[1611]—Mr. W. H. Jones (letter 1581, p. 114) says:—"My body is represented by the wooden part of a piano. The chords represent my mental faculties; the musician my soul." Would it not be more correct to liken the chords to our nervous organisation; the musician to the sensations conveyed to our brains by our five senses? May we not also liken the sounds produced by the playing of the musician to our cerebral or mental activity, which is set in motion by the impressions received from without?

From the recovery of consciousness from a state of suspended animation, W. H. J. argues:—"Mind can thus exist apparently apart from matter." As well might he argue from the resumption of the playing of an interrupted tune by a musical-box that "its sounds can thus exist apparently apart from matter."

We are next told that "mind is, however, unable to give proof of its existence except through a sound, healthy, organised body." Having no desire to be captious, I cannot help thinking that W. H. J. has here inadvertently made, what we are all more or less liable to make—a slip. Most sad, and bewildering, and terrible would be the condition of the world were all the diseased unable to give any proof of their being conscious.

Chas. Rose.

MIND AND BODY.

[1612]—Apropos of the subject "Mind and Body," now being discussed in the columns of Knowledge, there is, to my understanding, much said by those who are inclined to the belief that death does not end all, which is quite indefinite. For instance, they speak of having a physical body, a spirit, and a soul; all of which are in the possessive case. This kind of language induces me to ask, What is it that you imagine owns these? Whatever name you designate it by, that must be the immortal part, if immortal part there be. For it is quite evident that if there is a

something in the human constitution which does not suffer disintegration at death, that something must of necessity be the conscious self. Were it otherwise, whatever it was that came into being at death, must be something totally different from the controlling intelligence of this life.

If the immortalists will give a little thought to the above points, their cause will receive more attention.

Anent the very pertinent question raised by "F. W. H." as to what the soul does when unconscious, or what it can do "without eyes to see, ears to hear," &c., I think that, providing its existence can be proved, or reasonably inferred, there must be corresponding "soul senses," and that, like the conscious musician when his instrument is undergoing repair, we may reasonably infer that it is conscious of what is going on, but that on again using its instrument it fails, in the majority of cases, to impress the physical with what has taken place in the interval. I say in the majority of cases advisedly, for there are instances where this appears to have been done after the lapse of years. If the existence of the soul can be *proved*, then the above inference is admissible.

One cannot help wishing for an immortality, were it only to give an opportunity for amplification of the work entered into here, but which, for want of time, we have to leave only just entered upon. But who will solve the problem and for ever set the mind at rest? A. K. Y.

THE FALLACY OF MATERIALISM.

[1613]—Your Hylo-Idealists, Hylozoists, do not, as it would appear to me, quite comprehend Berkeley's standpoint in philosophy. It is this, that our outer and material universe is but an ideation of whose real, substantive existence we have no positive proof. We may, and do, believe that such exists, but belief is not certainty; nevertheless, we are compelled to attribute our conceptions of an external universe to external causation. Berkeley differed from his predecessors in assuming that this causation was spiritual instead of material. Berkeley's philosophy was essentially "animistic," and cannot be hybridised with materialism, call the attempt to do this by what name you will. Berkeley, however, takes his stand in an impregnable redoubt against the *positivism* of the materialists, for he convincingly demonstrates that the existence of an external, material universe cannot be proved, and that the belief in its existence is as much a belief as the belief the materialists would undermine. It is, therefore, on a belief, and not on an absolute certainty, the belief in the existence of an external, material universe, that your very positive science is built. In the becoming, or gradual formation of this belief, we have been led to doubt the veracity of our senses—whether our senses do always correctly report external things. It is difficult, even in these scientific times, to correct the misleadings of sense, as, for example, in the instances of colour and sound, and to convince people that these have no externality whatever, as colour and sound. It is perfectly true, however, as your correspondent, "C. N.," observes, that we do form our conceptions of external things from their appearances in sense, but this is accomplished by very slow degrees, and by correcting one kind of telegram from the outer world, by another; and though we cannot pass the pale of the laboratory of our own consciousness, we do *inferentially* transcend it, and obtain knowledge of things supposed to be apart from, and beyond, it. Independently, however, of these considerations, there is the important fact that our total consciousness is a *tertium quid*, which is neither the postulated *objective*, material things, nor the subjective nerves. Assert, if you will, that this third conscious essence cannot exist apart from matter, from "organisation in action"—say, that matter is its necessary vehicle—nevertheless, there it is, an essence superior to, and dominant over, matter; and, from this point of view, your materialism would appear to be a perverse placement, to use a vulgar expression, of the cart before the horse. It is of this third existency, essence, or life, of which the nature cannot be divined. And just as science can formulate the laws of life, without being able to divine what life and consciousness themselves are, so likewise in cosmical phenomena we come upon that "animistic" *attraction* of which Newton could expound the laws, but of whose power he—even he—could give no explanation. The earnest inquirer is met at every point with some mystery he cannot by any possibility solve. It is but the weakness of baffled science to substitute effects for causes. Does any of your automatic machinery approach the inexplicableness of the humblest form of life? Materialism, whilst repudiating ontological speculation, is itself ontological in its tendency, and does but substitute materialism for "animism" as a first cause, though at the same time admitting that its boasted *matter* is but an idealistic conception.

Is it some men's absoluteness, their desire for something tangibly, and ponderably, matter-of-fact, that makes them prone to bow down to that fetish, "matter?" And then—oh, inconsistency!—when they find that the motion of matter won't work, forthwith maintain that it is endowed with a *vis viva*. Endowed by whom? Ah, well! "endowed," they admit, is not the right word they ought to have used. "*Vis viva*," they meant to say, "is a property of matter." Why not matter a property of *vis viva?* But from this very fact that they are obliged to have recourse to a *vis viva* shows that they are obliged to revert to a *deus in machinâ*, and to bestow upon this *deus* a new title. Say that this motion—*vis viva*, life or spirit—is bound up—indissolubly bound up—with matter in the universe, why not bow to the moving spirit rather than to the matter moved?

This worship of matter is nothing more nor less than an intellectual reversion to the barbaric worship of stocks and stones. Reason for ever, and, nevertheless, there will be the great fact, the fact that can be neither gainsaid nor altered, that there is a Power competent to effect all that has been, is, or will be. It is of comparatively little moment what name is given to that power, for that stupendous power, by any name, will remain eternally the same. Look where you will into the civilisations of the past, and you shall find, as they gradually approached culmination, that rude stocks and stones gave place to winged images. Man progressed, and rose on spiritual pinions, and yet your *materialist*, in the face of all this evidence, would pluck from him the very plumes on which he soars. W. CAVE THOMAS.

[The disputants on both sides in this discussion might with advantage read the article on Berkeley, in Lewes's "Biographical History of Philosophy."—ED.]

CROLL AND THE BEGINNING OF LIFE.

[1614]—The table you give on p. 123 is the result, as you say, "of mathematical computations not open to doubt or question."

Exactly so; and, *consequently*—whatever may be the bearing on "The Beginning of Life"—I must first beg to observe that, consequently, not one figure of the table can have the faintest chance of approximate verity (beyond the well-known ·0168 of present eccentricity), or the remotest shadow of connection with any knowledge. On referring to Croll's "Climate and Time," it is plain that this table merely repeats the last third of his 3,000,000-year table. You have either not seen the source of the formulæ he used, as given on his p. 312, or not noted the data there given, or not looked into the nature of them.

Leverrier first published them, it seems, in the "Connaissance des Temps" for 1843; but also separately in 1845. The title of his pamphlet is "Mémoire sur les Variations Séculaires des Eléments des Orbites, pour les *Sept* Planètes Principales." Of course, only *seven* were then known; and he showed that whatever the number of planets to be taken into account, the eccentricity of each one of them is subject to that same number of inequalities, each having its own magnitude and period, dependent (each one) on the elements and masses of all the planets. That is to say, supposing *seven* acting planets (as he then did), the centre of each of their orbits must be describing a curve compounded of seven different circular motions, all of different radii, and different angular rates (or periods of turning). We must not (in any case, as that of the earth) associate any one of the seven inequalities with any particular planet, for *each* depends on *all* the planets. Now, I must beg your attention to the rates of angular motion of the seven arguments Leverrier then found for the earth's seven inequalities. Instead of copying each rate, I shall make it clearer by giving the number of revolutions and twelfths of a revolution that each argument had to make in a million years, the duration of your table, or rather of the last third of Croll's.

The argument of the biggest inequality,					
(which is	·0189)	makes	5	revolutions	10 signs
The next	(·0169)	„	13	„	9 „
„ third	(·0166)	„	2	„	13 „
„ fourth	(·0118)	„	13	„	3 „
„ fifth	(·0106)	„	4	„	1 „
„ sixth	(·0024)	„	17	„	4 „
„ last	(·0005)	„	1	„	9 „

These correspond, you will find, with Croll's figures, on his p. 312, and are the numbers of turns that he or his computers have supposed each of the arguments to make in one million years.

Leverrier took the trouble to reckon and give, in elaborate tables, the change that any small correction to the then supposed masses of any of those seven planets would make in both the magnitude of each of his 49 inequalities, and the rate of its argument's motion (consequently its period). No such correction has been applied, though the estimates of all the masses but Jupiter have had to be amended, since 1843, far more than he probably thought possible. But now just imagine faintly the effect on your precious list of maxima and minima by such a slight microscopic amendment in, say, the second biggest inequality's rate of

circulation as would make its revolutions in the million years *one* more or less than these 13¾!

Of course, the minute change of 5, or even of 1, per cent., in the rate of any of the first four arguments' movements, would utterly change the whole table's character—double, perhaps, some maxima, and turn others into minima!

After adding to his "Sept Planètes Principales," a few years later, a heavier than all but two of them—yea, heavier than the aggregate of all its five inferiors, of course, Leverrier, could little think of undertaking such a task as repeating all this for the sixty-four inequalities of all the eight! Will any one ever think it worth while? Not, I should say, unless with some grounds for thinking the list of colossal planets (the Jupiter-Neptune class) complete. A single addition must, like that of Neptune, make all antecedent reckonings as vain as these. It is not, observe, that Mr. Croll had to add an eighth inequality merely to the seven he has taken; but each of those seven is separately revolutionised, both in magnitude and period.

Moreover, it is not as an eighth added to seven, but a *third* added to *two*—the third heaviest of four (formerly three) that Neptune enters. His task, Leverrier found much eased by the insignificance of our four little inner planets in face of what he supposed the three big ones. Those he treated first by themselves as a "système qui est indépendant des autres planètes" (p. 46). But not independent, he soon found, of Neptune! Each of those that he treated as having but *three* of these inequalities, he would now have to reckon subject to *four*; and then treat the four interior as each subject to eight. He tabulated the elements of these (pp. 61, 66) on the then theory (of no Neptune), but no further than to 100,000 years, past and future; and, of course, would have been the last, I suppose, to have now assigned those reckonings any value beyond the 10,000. The earth's orbit's eccentricity, probably now below its average (though that is not certain), will continue decreasing for between twenty and thirty thousand years, to a minimum possibly as low as ·004; and in another 20,000 rise again to about its present value. Further than that, Leverrier would certainly have denied that a single figure of Croll's and your tables is worth the good vermin-killing arsenic or lead of its ink. E. L. Garbett.

P.S.—To show how utterly superseded and worthless, *even had Neptune never been found*, their great author must latterly have held the data whereon Croll's table (p. 123) is based, it may suffice to quote this from p. 23 of the "Mémoire," as printed in 1845, but calculated in 1839:—

"Si les quantités μ, μ^1, μ^2 . . . qui représentent les erreurs possibles des masses étaient considérables, la détermination des variations qu'elles pourraient introduire dans les coefficients que nous venons de calculer [*i.e.*, all those Croll has used] serait presque impracticable. Mais il est au contraire très vraisemblable que ces corrections ne sont que des petites fractions des masses admises aujourd'hui [1839], qu'ainsi pour Jupiter, μ^4 est au-dessous de ·002; que pour Saturne, μ^5 ne dépasse pas ·01; que pour Vénus, la Terre et Mars, μ^1, μ^2, et μ^3 ne dépassent pas ·04. Les masses de Mercure et d'Uranus seules présentent une grande incertitude, et il ne serait pas impossible que μ ne pût s'élever à $\frac{1}{3}$, et μ^6 à $\frac{1}{10}$, ou même plus."

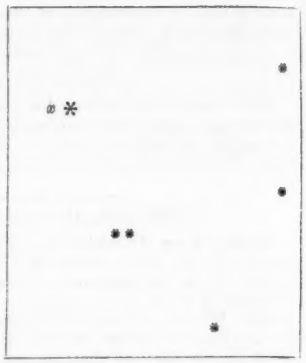
Now, in only two cases, Venus and Saturn, have the amendments he found necessary in the "Annales de l'Observatoire" been within the limits he had thus anticipated as possible. The denominator of Jupiter's mass, 1,050, which was not to err 2 thousandths, has risen in Chambers's "Astronomy" (on Leverrier's authority) to 1,046. That of the earth's mass, not to err beyond 4 per cent., he soon made from 356,354 into 314,000—a change above 13 per cent. ("Ann. de l'Obs.," 1858). That of Mars, limited to the same possible error, falls 12 per cent., from 2,680,387 to 2,994,790 ("Annales," 1861). That of Mercury, which he reckoned as 1,909,706, which "ne serait pas impossible" to err by a *third*, he had to lower by three steps, finally to 5,300,000! And the denominator of mass of Uranus, which might have to be altered a *tenth*, "ou même plus," falls from his 17,918 to 24,899 in Chambers, or *less than three-quarters* thereof.

Even had his elaborate corrections then been applied (which none have), and were there *no Neptune*, I should deny that we have the slightest knowledge whether the terrestrial eccentricity, say 50,000 years ago, was increasing or decreasing, or that one maximum or minimum in this table can teach us more than if the whole had come from shaking a lottery-bag. E. L. G.

"WHAT MAN HAS DONE."

[1615]—I hold it important that nothing that has been done should be stamped by the editor of Knowledge as impossible. Lately, sir, you spoke of looking through a refractor at the sun "of course, with a smoked glass." That, of course, is otiose. In May, 1845, at 11 a.m., I, being then thirteen, in lat. 54° N., looked steadily at the sun through a glass (2-in. object-glass, if I remember rightly; it showed Jupiter's satellites well in all unclouded weather) surveying the spots, &c. I cannot say how long—perhaps ten seconds. I had no pain or other inconvenience after, and that eye is now keener than the other. I cannot understand how I escaped; the more as Socrates remarks in the "Phædo," that those who look *direct* at the *eclipsed* sun, instead of at his image in still water, lose their sight. This shows, by the way, that smoked or coloured glass was not used, though Socrates speaks (in the *Clouds*) of burning-glasses, and a darkened glass is simpler than a lens.

In Jan. 1877, I glimpsed a star at about x in this diagram of the face of Taurus. I have tried hundreds of times since, but never saw it again till last month, and a few nights ago.* It must be a telescopic; or is it a variable, with long period? I should be much interested if you would tell me of what magnitude it is.



In 1864, a friend showed me a page of the *Times* photographed in *carte de visite* size. I at once read four lines of the first leader, quite fluently; but was there stopped by an intense pain in both eyes. I find that the height of the letters would be one-sixth of that of the leader type of the *Times*. An oculist told me I had gone very near blindness.

I am delighted you have taken up the question of bad type. I have long thought severe legislation, prohibiting small type altogether, can alone save our posterity's eyesight. I find my sight failing now; your correspondence type wearies me even in strong daylight; italics I find much harder than Roman letters, and Greek more trying than these. MS. I find perfectly easy to read, which I should not have expected. From these data, were I to bring in a Bill, I should propose to print Greek books in Roman letters (as was often done in the middle ages; they used Greek letters for non-Greek tongues also), to prohibit the use of any type below, say, that of your principal articles, and, above all, to cease the printing of notes and extracts in smaller type. The eye has to change its focus; this practice is the most trying of all printer's devilries, save the American one of beginning an article in decent type, and screwing you up, line by line, to a sort only half as large,

I reported to you once that, in March, 1881, I had, aided by a globular nimbus, seen Venus as a crescent with the naked eye. You replied in an early number of Knowledge that it was impossible; but I am as certain it was true vision as I am of my boyish feat with the sun, which I know must seem to most appropriate to Apollo chiefly on the *bow* side. Hallyards.

[I am wholly unable to recognise the asterism drawn by "Hallyards." If, by the aid of a star atlas, he will letter the principal stars in the group, I may be able to tell him something about his x.—Ed.]

FORECASTING THE WEATHER.

[1616]—Under the above heading there appear, in an Almanack distinguished for the amount and value of its information, certain remarks which I think are incorrect. They appear to have been written by a member of a weather-office, and have remained unaltered for the last nine or ten years.

They begin thus:—"Depressions on the surface of the great aërial ocean surrounding the globe are marked by the barometer."

Now, the "great aërial ocean," or, in plain language, the atmosphere, is subject to the laws of gravitation, like all other matter. It is densest at the surface of the earth, and becomes more and more attenuated the higher we go, till it finally disappears. It, therefore, has no surface, and can have no depressions.

The barometer merely measures the weight of the atmosphere.

The writer in the Almanack apparently does not know the reasons why the atmosphere is so much lighter during gales of wind and storms of rain, and so much heavier during the prevalence of fine weather and light airs.

He then informs us that storms travel with a velocity varying

* Not with direct vision, but as an undoubted fact, and more so than in 1877.

from twenty to forty miles an hour, which is probable enough. But, he continues, "we have the testimony of captains of some of the transatlantic steamers that they have experienced heavy gales on the American coast which have travelled with them all the way to Europe with unabated force."

How is this possible? No steamer that ever was built could cross the Atlantic during a continuous gale at an average speed of thirty miles an hour, or even half that.

The article concludes with the remark that "very much yet remains to be done before we can call meteorology an exact science." This is indisputable. SIGMA.

[While I am absolutely in accord with "Sigma" in his concluding sentence, he seems to me to misapprehend the passages on which he comments. For (1) The atmosphere undoubtedly has a surface as sharply defined as that of the ocean itself; and (2) I cannot read the part he quotes with reference to the Atlantic gales as indicating that a steamer has ever got into one particular part of a (more or less) cyclonic disturbance, and travelled with it 3,000 or 4,000 miles! The vessels may well have run into and out of half-a-dozen vortical depressions travelling approximately in one direction during her voyage.—ED.].

PHOTO-MICROGRAPHY.

[1617]—In reviewing "Photo-Micrography" by A. C. Malley, you say that "many observers are sufficiently expert in sketching with the camera lucida, the neutral tin plate, or Sömmering's steel disc; but unfortunately their witness does not always agree together, and their draughtsman will not unfrequently give very different sketches of the same object."

I met with a very striking illustration of the latter part of this sentence last week, and I take the liberty of sending you the photo and the notes I made upon it. I have done a little at photo-micrography for some years, and feel sure you would do many of your readers great service by showing its advantages. It was no small trouble in the old collodion days, but it is simplicity itself now, and the advantages are both many and great.

The photograph represents one of the two mandibles of the parasite of the beetle (*Gamasus Coleoptratorum*). The length is only the one sixty-sixth part of an inch, and it is only about the one five-hundredth part of an inch in width. In the "Micrographic Dictionary," a widely different representation is given of it from that revealed by photography; and it is not difficult to see that no great harm could be done if the mandible were such as there represented. Every one who has looked at the parasites which cluster on the under surface of the beetle, must have wondered how they contrived to keep their hold upon a host so active, and with a body so little likely to afford a safe footing; and then, if able to keep their hold, how do they obtain their food from a creature so well-armed as the beetle? An examination of the feet of the *Gamasus Coleoptratorum* shows that he will not be easily shaken off; while the pair of mandibles with which it is armed suggest the power it has of obtaining food.

The part of the mandible here represented, when cut off and mounted in Canada balsam, is only just visible to the naked eye, but when enlarged, presents, with its finely pointed and gracefully curved hooks, with their three teeth on each side, a sufficiently formidable instrument of torture. GEORGE SOUTHALL.

[This letter was accompanied by a photograph of the mandible of the *Gamasus coleoptratorum*, and a fac-simile sketch of the engraving of the same object in the "Micrographic Dictionary." The very considerable difference between the natural and artificial representations of the same object is, as Mr. Southall intimates, very striking, and well illustrates the justice of our reviewer's dictum on p. 134.—ED.]

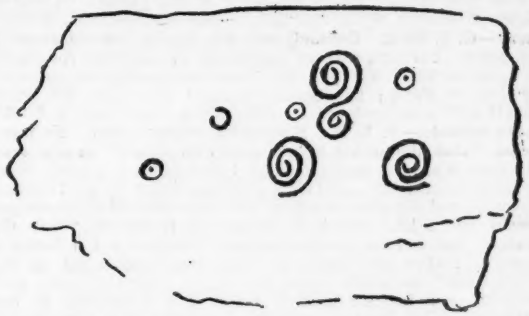
THERMO-CHEMISTRY.

[1618]—It is a well-known fact that when two elements combine heat is either rendered latent or latent heat is rendered apparent, according as the combination of the atoms in the compound is (1) less strong or (2) more strong than the combination of the atoms in the elementary molecules. Has any good explanation been given of this fact? If not, does the following theory explain it?—That since atoms of different elements have a greater attraction for one another than atoms of the same element, the atoms in the molecule of the compound will vibrate with smaller paths than they would when existing in the molecules of the several elements forming the compound. The energy representing the difference of these two sets of vibrations would be given off in the form of heat. This theory would explain the observed phenomena, since the stronger the chemical compound the more heat is there developed on its formation from its elements. Also, it is certain that, whatever the cause of the heat which is given off, this heat is produced by changes inside the molecule.

I know not if the Theory of Vortex Atoms offers any solution of these thermo-chemical difficulties. Perhaps you could enlighten me on this point. GILES DAUBENEY.

INSCRIBED ROCKS.

[1619]—In going through a field here a short time ago, I happened to cross one of those rocky knolls, common in this district, covered, all but a small patch on the top, with a thin coating of turf. On this bare spot I noticed what looked like part of a rough circle close to the edge of the grass. Turning back the turf, I found a spiral figure about 15 in. in diameter inscribed on the rock. Further investigation revealed a number of figures somewhat like what I have drawn below, roughly cut and evidently much worn,



in some parts almost gone. In the same field, at a distance of about 50 yards, I have since discovered another similarly-inscribed rock; and in a neighbouring parish, during one of last winter's storms, a group of the same kind of markings was exposed on a flat rock surface by the blowing over of a large tree.

Can any of your archæological readers inform me as to the origin and use of these inscriptions? HUGH MCMEISTER.

THE DOCTRINE OF CHANCES.

[1620]—Whitaker's Almanac for this year contains an article on "The Doctrine of Chances," which gives some clear information on the subject in a condensed form. But the illustration of the subject numbered 9 at page 408 of the Almanac is curiously erroneous. The so-called illustration is as follows:—

A speaks truth three times out of four, B four times out of five, C five times out of six. What is the chance of the truth of an event which A and B agree in asserting, but which C denies? The event (according to Whitaker) happened, if A and B both speak the truth and C lies; it did not happen if A and B both lie and C speaks truth. The chance is therefore as follows (I am still quoting Whitaker):—

$$\frac{\frac{3}{4}\times\frac{4}{5}\times\frac{1}{6}}{\frac{3}{4}\times\frac{1}{5}\times\frac{1}{6}+\frac{1}{4}\times\frac{4}{5}\times\frac{5}{6}}.$$

This fraction is equal to $\frac{12}{17}$, therefore the odds are 12 to 5 in favour of the event having taken place.

Whitaker does not perceive that the system of multiplying the fraction which represents one probability by the fraction representing another probability is in no wise applicable to the case which he has created. Such a system would lead to most absurd results. For instance, if a million people testify to an event, common-sense tells one that it is highly probable to be true. But the plan of multiplying fractions representing each individual's credibility would lead to a very minute product when a million persons are involved, and would tend to show that a fact testified to by many witnesses, instead of being highly probable, is just the reverse.

The proper way of dealing with such a problem seems to be to take for it the chance of both A and B lying. This is $\frac{1}{4}\times\frac{1}{5}=\frac{1}{20}$. Therefore the chance of their speaking the truth is $\frac{19}{20}$, so that it comes to weighing the words of a person who speaks the truth nineteen times out of twenty against that of another who speaks it five times out of six. Modifying Whitaker's formula in this manner, the odds come out 19 to 5 in favour of the event, instead of 12 to 5. CHAS. G. SHAW.

LETTERS RECEIVED AND SHORT ANSWERS.

JAS. BOWMAN. Shall have immediate attention. The note was part of the advertisement. The publishers had nothing whatever to do with it.—M. F. W. sends a sketch of a pair of champagne nippers, "registered Aug. 10, 1878," which he imagines to be

identical in principle with the "fish" nippers described on p. 117. The latter, however, act by opening, while M. F. W.'s appear to do so by closing. The latter cost a shilling. The former so small a fraction of a penny that they are given away.—Chas. Rose. Marked for insertion, the purely theological portion being excised.—C. C. Davis. Your tracing is, *per se*, valueless, because everthing depends upon the aspect of the window. Dialling is a matter of spherical trigonometry, and all I can say here is that the edge of the gnomon must, in every case, be parallel to the axis of the earth. Go to some second-hand bookseller's, and get such a book as Ferguson's "Dialling," Leybourn's "Dialling Improved," by Wilson, &c.—Leipsic. Nothing surpasses Chauvenet's "Spherical and Practical Astronomy," published by Lippincott & Co., of Southampton-street, London. For details of the aspect of the sky, consult Webbe's "Celestial Objects for Common Telescopes." Star Charts in the "New Star Atlas" by the conductor of this journal. Celestial globes of Newton, Wyld, Stanford, or any geographical establishment.—G. P. Mack. Certainly man can exist at a temperature of 0 degrees. I cannot, without an amount of searching for which I have no time, tell you the lowest temperature experienced by Captain Nares; but Gorochow noted −81° (*i.e.*, 81° below zero!) at Werchojansk, on Dec. 30, 1871; this is only in 67° 20′ north latitude.—P. L. W. Newcomb's.—Uncle John. No proof exists "that this planet is in a semi-fluid state;" at any rate, the crust is so thick that the entire globe behaves as a solid. Were it otherwise, the thin, solid shell would slip round the fluid internal spheroid, and the phenomenon of the precession of the equinoxes would not exist. No; it is absolutely *impossible* "that the planet has a rotation from north to south of a few inches a year!" I have not heard of "the rapid movement of the fixed stars" to which you refer.—E. A. Tindall. My good sir! do not imagine that I resent the expression of any reader's opinion (be he a subscriber or not) upon a question on which he is competent to give it. I merely entered a mild protest against your quasi-Papal fashion of teaching me how to edit this paper.—A. J. W. The explanation of the telescopic disc of a star involves some pretty abstruse mathematics, the phenomenon being dependent upon the very nature of light itself. In fact, the larger the aperture of the telescope the smaller that disc is. It is the quantity of light we receive from a star which determines its "magnitude." All fixed stars are, in reality, absolute *points*. A planet is a totally different thing. It is sufficiently near for us to see its real surface. Here is a simple experiment for you. Focus your telescope, with its full aperture, on Jupiter. Now, by the aid of a blackened card diaphragm, cut down the diameter of your object-glass to 1¼ inch, and again look at the planet. Its size will remain the same; albeit it will look very much dimmer. Repeat this with a star, and you will find that the cutting down your telescopic aperture will notably increase the size of the spurious disc.—T. Crawford. Thanks for the trouble you have taken; but the length to which the extracts run render them quite inadmissible. The divining rod (or "finding-stick" of the West of England) is a very old superstition. For a rational explanation of its action read Carpenter's "Mental Physiology."—R. T. Palmer. No; the question was never answered. Can any one inform our correspondent how glass-tube pens are made?—H. Pilley. Chambers' "Mathematical Tables," published by W. & R. Chambers, London, will certainly suit you. Price not given, as this is not an advertisement column; but it is a cheap book, under four shillings.—J. H. D. points out, justifiably enough, the "fanciful absurdity" of supposing that "height and depth" in Ephesians iii., 18 v., represent separate dimensions, as alleged by "E. L. G.," in letter 1588, p. 137.—Latitude. As good and cheap a book as you can obtain is Young's "Navigation and Nautical Astronomy," published by Crosby, Lockwood, & Co. in "Weale's Series." There is a volume of tables in the same series for use with it, which I have some idea you may get, bound up with it. At any rate it is purchasable separately.—Antony Gibbs. I am ignorant where the fire-extinguishing grenade is procurable—J. W. Manning. No mistake whatever; 5½ feet represent the *focus* of the object-glass, not its aperture. To an eye, 5½ feet on the other side of the focal image formed by such an objective Jupiter, or any other object, would appear of the same size as he does to the naked eye. As, however, we approach this image we obviously begin to magnify it.—A. E. R. I know of no such tables; but, of course, an ordinary proportion sum will enable you to find what you want; 1 lb. of coal will raise 14,000 lb. of water 1 degree, whether such water be at a temperature of 35 or 79.—A. J. Gaskin. 1. The fault is not due to the formation of "an electric film," but to the fact that the current is not strong enough to properly govern both sets of electro-magnets simultaneously. Probably your lower lamp offers less resistance than the upper one. Measure the resistances if you can. By increasing current, or joining the lamps in series instead of parallel circuit (providing you can get the necessary E M F), you will probably be able to overcome the difficulty. In the latter case, however, you would require short-circuiting plugs or switches. 2. The impression of the steps, &c., probably had its origin in their radiating heat at a slightly different rate to the surrounding water, and so modifying its crystallisation. The subject, though, is obscure.—E. C. R. Your "extra luminous patches" on the sun were nothing in the world but *faculæ*, which were first observed by Galileo some 274 years ago. See Knowledge, Vol. IV., p. 179.—H. C. Wellington. No books or pamphlets have, so far as I am aware, been published on the new method of reckoning time; although a mass of correspondence on the subject has appeared in divers journals.—J. Herbert. While quite agreeing with you as to the desirability of the adoption of the new time, I greatly fear that the chances of its being so adopted are rather remote. I have it on good authority, that a strong opinion against changing the existing mode of reckoning was expressed at the recent meeting of the Royal Astronomical Society; and if astronomers, as a body, set their faces against it, the chances of its ever coming into popular use are very small. The "Nautical Almanacs," moreover, so far published (*i.e.*, up to 1888), adhere to the old form of reckoning. For this reason I think it improbable that "F.R.A.S." would be disposed to make any change in his "Face of the Sky" until the question is more definitely decided.—Walter Moodie. The *Dramatic Review* is published at 12, Catherine-street, Strand, London. Price not given for a reason repeatedly stated.—M.D. (Glasgow). For reply to your first query see Knowledge, Vol. V., p. 351. In answer to your second, the time kept at the railway stations, post office, &c., is Greenwich time, and the phenomena of Jupiter's satellites, of course, will occur at the times given. But *Glasgow* time, *i.e.*, the time obtained by the transit of the sun or a star over the meridian of Glasgow, is 17 min. 11 sec. before that at Greenwich. For example, Greenwich mean midnight would be only 11h. 42min. 49sec. p.m. at Glasgow by local time.—W. H. G. kindly sends us the information that a course of six lectures is now being delivered at Derby under the auspices of the Gilchrist Educational Trust. The lectures take place every Wednesday fortnight. They began on Jan. 21, and will terminate on March 25. Our obliging correspondent omits to mention the subject.—Cymro. The pole of the heavens is simply that point in space to which the extremity of the earth's axis points. Hence, if that axis have a conical motion the celestial pole will describe a circle in the sky, which, as a matter of fact it does. In the time of Hipparchus our present Pole star was 12° from the Pole; 215 years hence it will be less than 30′ from it. After some 12,000 years or so Vega will be the Pole star, and so on. Of course as the Equator is always 90° from the Pole it will have a corresponding motion, which gives rise to the Precession of the Equinoxes.—H. Trueman Wood. Received with thanks.—The President of the Society of Architects. Received with thanks.—Borderer. I am tempted to think that if springs "break" immediately upon a gale of wind it must arise from the very great diminution of atmospheric pressure which occurs at such a time. The subject of the actual temperature of the sun is one on which we possess but few trustworthy data to guide us. On the whole the most probable temperature of the solar surface is not far from 18,000 deg. Fahrenheit. The most intense obtainable artificial heat scarcely reaches 4,000. Nothing is known of the central heat of the sun.—H. Brain. Where the ball is hit fairly in the middle, the angle of reflection *is* equal to the angle of incidence; where "side" or "screw" is employed a ball may be made to do all sorts of things.—T. Lyne Coode. I have no pamplets on cremation whatever. Write to W. Eassie, Esq., 11, Argyll-street, London, W. See paragraph in capital letters with which the heading of the correspondence column concludes.—James Burn. Too purely theological for admission.—F. W. H. I am afraid that we are drifting into mere logomachy.—Sir John Lubbock. Received with thanks.—Lover of Knowledge asks for an explanation of the theory of ginger-beer plant; and further, whether after fermentation it is intoxicating in any degree, and what effect it has on the human system as an article of food?—Anthropological Institute and Parkes Museum. Received with thanks.—An Earnest Thinker. Indeed I am not ungrateful for the real courtesy and kindness which can alone have prompted your gift of "The Blessed Hope"; but I can only repeat the words of the Scottish idiot on returning the dictionary which some one had lent him: "I've read it a' through; but eh! it's a vair disconnectit buik!"

The Cutler's Company of Sheffield approved on Wednesday a scheme for holding an Industrial Exhibition illustrative of Sheffield manufactures during the coming summer. The Duke of Norfolk has promised a handsome subscription, and over £1,000 has been contributed to a guarantee fund.

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (Knowledge *being a popular magazine*) *than is accorded by the most excellent trade journals.*

READING STAND.

[Patented 1884.]—This is a simple, secure, and convenient support for newspapers, magazines, books, &c., while being read at table, or by invalids in bed. Patented by Major-General Davis. The weight of the base is such as to ensure stability, even at the extreme edge of a table. A wire cord with a weight at the left side is so arranged as to lie over the margin of a book, and keep the leaves open. The right side of the wire cord, being lighter, is easily raised with the leaf in turning over, and thus only one hand

need be used. The weight can, however, be moved on the cord if desired. The upper surface of the base is covered with Utrecht velvet, which prevents the newspaper or book from slipping. The wire frame is also made to fold down flat for convenience of packing, and to slope back so as to be adapted for various sizes of books. The stand is also useful for supporting music, drawings, documents, &c., while being read or copied.

VENTILATOR AND WARMER.

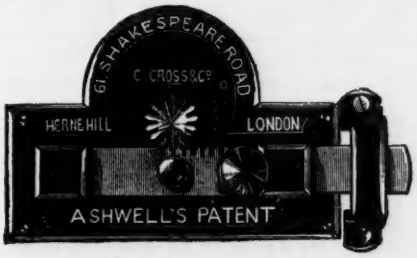
[Patent No. 3,725, 1884.]—Mr. George Crapper, of Chelsea, Middlesex, has patented an invention relating to a simple means for utilising the otherwise waste heat from kitchen-ranges or other fireplaces for the purpose of ventilating house-drains and soil-pipes or for warming and ventilating apartments. The ordinary system of soil-pipes is retained, and continued up above the parapet or eaves of the roof of the house as heretofore, but the cowl on the top is dispensed with. A cast-iron air heating chamber is fixed in the flue at the back of the range or fireplace, and from the bottom of such chamber a wrought-iron pipe is connected with the nearest point in the drain. From the top of the said chamber a ventilating or up-cast pipe is carried to a sufficient height in the flue through the side of the chimney jamb or otherwise to the external wall, whence it is carried up above the parapet or eaves of the roof. The action of the heat in the flue raises the temperature of the chamber, and thereby causes a powerful current of air to pass down the soil-pipe, along the drains, and up the up-cast pipe or shaft. The direct communication of the drain with the sewer is cut off as usual by means of a syphon trap with inspection chamber, which chamber is provided with an inlet for fresh air fitted with a mica or other suitable valve opening inwards, so as to be closed by the internal pressure. It will also be readily understood that, by carrying the pipe which communicates with the lower part of the heating chamber out into the open air in lieu of into the house-drains, a constant supply of pure air may be drawn into the said chamber, and directed in a more or less heated condition by pipes leading therefrom to any part of the building, thereby effectually warming and ventilating it.

DOOR-MATS.

[Patent No. 5,994. 1884.] A new form of mat has been patented by Messrs. Bates & Co., in which strips of vulcanized india-rubber are arranged between bars of wood, metal, &c., these being kept apart by small washers, and the whole secured together by rigid or flexible fastenings as may be required. The india-rubber protrudes above the wooden strips.

INDICATING DOOR-FASTENER.

This is a very ingenious piece of furniture, patented by Mr. Ashwell (who has entrusted its manufacture to Messrs. H. & E. J. Dale, Ludgate-hill, E.C.) The fastener is fixed in any convenient part of the door of the apartment to which it is to be applied. The illustrations may almost be left to explain themselves. By



Inside view of bolt, half actual size.

simply bolting the door, the word "Engaged" is shown up on the outside of the door, and when the bolt is withdrawn, a white space appears in the place of the word "Engaged." This invention is

External view of bolt, half the actual size.

particularly useful for the doors of consulting-rooms, photographic studios, passenger ships, hotels, &c. They are extremely neat in appearance, durable, and can be easily fixed upon doors of any thickness, only requiring a small hole for the spindle to pass through the door. Its actual size is but three inches in diameter.

The Electric Light in Industrial Establishments.—It is now universally conceded that the value of electric illumination in industrial establishments is measured by its intrinsic worth in several particulars, each tending to increase or improve the production manufactured under artificial illumination rather than its cost in comparison with other methods of lighting. An unexpected merit in electric illumination was recently forced upon the attention of the agent of a textile mill corporation in the United States, engaged in manufacturing fine sheetings, who introduced an incandescent electric lighting plant, which lighted about half of the mills, the remainder being lighted as before by gas produced from the destructive distillation of petroleum. He received a letter a short time later from the bleachery where the goods were finished, stating that for some unknown reason about one-half of their goods appeared dead and lustreless in comparison with the extra finish obtained upon the remainder of the goods, which had been subjected to the same processes. The result of a very careful investigation showed that the unsatisfactory appearance of the cloth was due to the small motes of carbon deposited by the burning gas, and that the freedom from such carbonaceous matter in the mill where the electric light was used rendered possible the more brilliant finish to the goods.—*Engineering.*

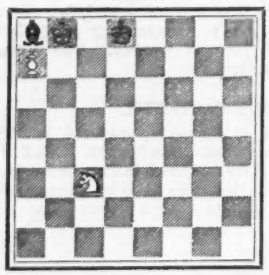
XUM

Our Chess Column.

By Mephisto.

USEFUL END GAME.

Black.

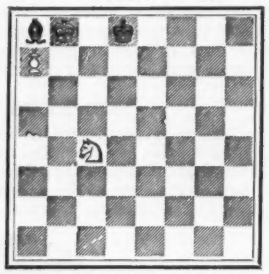


White.

White with the move can only draw.

1. Kt to R4 (*a*)	B to R8
2. Kt to B5	B to R sq.
3. Kt to Kt7 (ch)	K to Q2
4. K × B	K to B sq. (*b*)

Black.



White.

White wins with the move.

1. Kt to R5 (*c*)	K to Q2
2. Kt to Kt7	K to B3
3. K × B	K to B2
4. Kt to Q6 and wins	

(*a*) If 1. K × B, Black draws by K to B2.

(*b*) Black draws, as White cannot possibly prevent the Black K from occupying either B sq. or B2, for the obvious reason that with every move the Kt occupies a square of different colour; so does the Black K, which prevents the Kt from commanding either B8 or B7 without giving a check and having to move again. But put the Kt now (anywhere) on a black square, then White will win.

(*c*) If 1. K × B, Black draws by K to B sq.

CHESS IN SCOTLAND.

Game played by correspondence.

King's Gambit.

White. F. J. D.	Black. R. P. F.	White. F. J. D.	Black. R. P. F.
1. P to K4	P to K4	13. P to K5	Q to R5
2. P to KB4	P × P	14. B × P	B to R3 (ch)
3. Kt to KB3	P to KKt4	15. Kt to QB4*	P to B6 (*g*)
4. B to QB4	P to QKt4 (*a*)	16. B to Q3	Kt to K2
5. B × QKtP (*b*)	P to Kt5	17. B to K4	Kt to Q4 (*h*)
6. Kt to K5	Q to R5 (ch)	18. B × Kt	R × B
7. K to B sq.	P to KR4	19. P to QKt3	P × P (ch)
8. Q to K sq.	Q to KB3 (*c*)	20. K × P	Q to R6 (ch)
9. P to Q4	B to QKt2 (*d*)	21. K to Kt sq.	B to QKt2 (*i*)
10. Q to QB3 (*e*)	Kt to QB3	22. Q to Q2	R to Q sq.
11. Kt to Q2	Castles (*f*)	23. Q to KB2	P to R5
12. Kt × Kt	P × Kt	24. Resigns (*j*)	

NOTES.

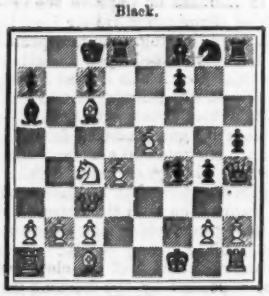
(*a*) Black has nothing to gain by this move.

(*b*) Or B to Kt3, if he wishes to continue the attack.

(*c*) Black has a cramped position; he would have done better to exchange Queens.

(*d*) B to QR3 was preferable.

Black.



White.

* Position after White's 15th move.

(*e*) Good! If Black plays B × KP. 11. Q × P, with a dangerous position. If P to B3, 11. B to R4, and Black's pieces on the Q's side are hemmed in.

(*f*) Kt × Kt or B to Kt5 might have resulted in a safe defence.

(*g*) A vigorous counter attack.

(*h*) Compelling White to play B × Kt, parting with his useful KB, for if Q moves, Kt × B, winning a piece.

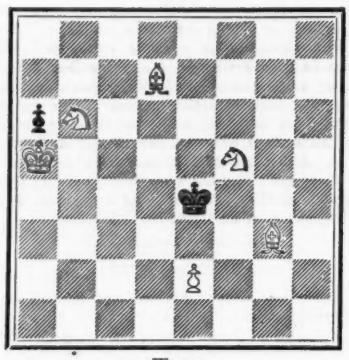
(*i*) A subtle device called a masked battery.

(*j*) Black threatens P to Kt6, which White cannot prevent. If 24. Kt to R5, P to Kt6. 25. Q to K2, P × P (ch). 26. R × P, R to Kt sq. (ch) and wins.

PROBLEM No. 149.

By W. Coates.

Black.



White.

White to play and mate in three moves.

SOLUTION.

Problem No. 147, by O. H. Labone, p. 140.

1. Q to R4	K × Kt, or	1.	K to B4
2. P to Q4 (ch)	K to Q3	2. Q to Kt4 (ch)	K × Q
3. Q to Q8 (ch)	Mate	3. P to Q4 (ch)	Mate

If Black moves the Kt or the P on Q4, 2. Kt × P and mates accordingly. If P to B4, 2. Kt to B7 mate.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

C. E. L. D.—Though a piece giving check is pinned in front of its own King—in fact, under no conditions whatever—may a King move into check.

Partenope asks "whether it is allowable to exchange a Pawn reaching the 8th sq. for a piece of the opposite colour." We do not care whether it is allowable or not—it is nonsense in any case; and if the law permits of this, then the sooner practice does away with the law the better. Therefore we say decidedly not.

Ravenshoe points out that our note "*j*" to game p. 162 is not quite correctly worded. White would first move his K to **R** 2, then the threat of R × Kt would hold good, for if R × Kt at once Kt to B6 is impossible, the white Kt being pinned by the B.

W. W. Beaumont.—Problem received with thanks.

Correct solutions received: Problem No. 147, W., E. Louden. Problem No. 148, W., Ravenshoe, E. Louden, W. T. Hooten.

Contents of No. 173.

	Page
Our Two Brains. By Richard A. Proctor	141
On Termites. (*Illus.*) By Surgeon-General R. F. Hutchinson	142
Pleasant Hours with the Microscope. (*Illus.*) By H. J. Slack	143
A Remarkable Landslip and its Causes. (*Illus.*)	144
The Origin of Comets. By Richard A. Proctor	145
The Philosophy of Clothing. II. (*Illus.*) By W. Mattieu Williams	147
Plant Life and Planet Life. By Richard A. Proctor	148
Future Arctic Work. By Lieut. Greely	149
The Speedwell Cycling Show	150
Other Worlds than Ours	151
The Young Electrician. (*Illus.*) By W. Slingo	152
Chapters on Modern Domestic Economy. XVI.	154
Editorial Gossip	155
Highest Temperatures Endurable by Fish	156
Correspondence	156
Our Inventors' Column	161
Our Chess Column	162

NOTICES.

Part XL. (Feb., 1885), now ready, price 1s., post-free, 1s. 3d.

Volume VI., comprising the numbers published from July to December, 1884, is now ready, price 9s.

Binding Cases for all the Volumes published are to be had, price 2s. each including parcel postage, 2s. 3d.

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